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ECONOMIC AFFAIRS

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GOSPLAN OFFICIAL DISCUSSES IMPROVEMENT OF ECONOMIC MANAGEMENT

Moscow SOTSIALISTICHESKIY TRUD in Russian No 6, Jun 79 pp 29-36

[Article by N. Drogichinskiy, division chief of USSR Gosplan]

[Text] In recent years our party has been paying enormous attention to management of the economy. In his address containing the report of the CC CPSU to the 25th party congress Comrade L. I. Brezhnev pointed out that now when the correct policy has been worked out and the correct line determined, organization--that is, further improvement of management of the economy in the broadest sense of the word--is becoming the decisive area. A unified system of measures covering the principal aspects of economic management have to be worked out and implemented, as L. I. Brezhnev noted, in order to cope with the task of faster reorganization of the economic mechanism. Reorganization of the management structure of our economy occupies an important place in that system.

In the decree of the CC CPSU and USSR Council of Ministers entitled "On Certain Measures To Further Improve Management of Industry," which was adopted in early 1973, ministries, departments and councils of ministers of union republics were ordered to work out master schemes for management of sectors and industries, making provision in them for the transition to optimum two-tier and three-tier systems of management on the basis of specialization and concentration of principal and auxiliary production and creation of large production associations. In that connection the goal was set of reducing the number of tiers of management to a minimum and to bring management closer to production itself.

The first stage of this large and complicated job has now been completed. The drafting of the master schemes for industrywide systems in the industrial sector, outlined by the decree of the CC CPSU and USSR Council of Ministers, has been completed for all practical purposes, and they have been approved for 34 industrial ministries, which made it possible to considerably reduce the number of management units and entities being managed. Thanks to implementation of the master scheme, as of 1 January of this year more than 3,800 production and scientific-industrial associations were functioning in the industrial sector; they encompass about 17,000 plants, factories, mines and other organizations, 600 scientific-research and project

planning and design organizations; and approximately 700 bodies of management in the middle tier were eliminated. The size of the managerial apparatus was reduced by almost 110,000 persons.

The figures below indicate how much the role of production associations has been enhanced in the country's economy. Whereas at the beginning of the Ninth Five-Year Plan they had a share of 6.7 percent in the volume of industrial output, last year this figure exceeded 46 percent. Certain ministries have achieved a still higher concentration of production: the Ministry of Coal Industry provides 93.5 percent of the total volume of its sales thanks to the efforts of production associations, the Ministry of Timber and Wood Processing Industry 75 percent, the Ministry of Pulp and Paper Industry 70 percent, and the Ministry of Automotive Industry 63 percent. Production associations are producing 98 percent of the coal, 94 percent of the motor vehicles, more than four-fifths of grain-harvesting combines, more than two-thirds of the looms, and a sizable portion of chemical fibers, electrical equipment, furniture, footwear, sewn garments and knitwear.

Indicators of production and economic performance in the associations are better than for the industrial sector as a whole. For instance, in the years of the Ninth Five-Year Plan the volume of production rose 47.6 percent in the associations, which is 4.4 points better than the average for the industrial sector. Labor productivity rose 38.2 percent against a growth of 33.6 percent in the industrial sector as a whole. The production associations of the Ministry of Instrumentmaking, Automation Equipment and Control Systems increased the volume of their production almost 2.8-fold, while the average for the industry was 82.7 percent. A similar situation is taking shape in a number of other sectors of our country's economy. The most important task set by V. I. Lenin--authentic socialization of production--is being accomplished thereby.

It is equally important that the ratio between large and small enterprises, i.e., the indicator of the concentration of production, has improved considerably as a result of the creation of production associations. Between 1960 and 1975 the relative share of small enterprises with a work force of 200 or fewer decreased from 63.6 to 55 percent, and in terms of output the drop was from 15 to 9.5 percent. At the same time the relative share of enterprises with a work force exceeding 1,000 nearly doubled, and their output was more than 65 percent of the total in 1975. The relative share of enterprises with a work force exceeding 3,000 nearly tripled, and the relative share of their output exceeded 40 percent of the total.

It is a very important fact that implementation of the master management scheme has stepped up efforts toward specialization and concentration of principal and auxiliary production, toward specialization of production associations and their constituent enterprises, and toward concentration of preparatory, repair, tool, warehouse, construction and other production operations. The organization of work, of production and of management is improving, and computer centers for production management and process control are being set up.

In the final analysis this was the purpose of organizing the associations. Conditions are brought about in them for planned retooling of production on the basis of the most recent technology, for improvement of the organization of work, of production and of management, and for the drafting of scientifically sound and effective long-range, 5-year and current plans. The maximum economic and social benefit is thereby ensured. It is sufficient to say that in the 10th Five-Year Plan a saving in excess of 17 billion rubles is to be achieved thanks to performance of this program for improvement of economic management.

In addition to the favorable results, there have also been essential shortcomings that have been detracting from the possible benefit of adopting the measures outlined by the decree of the CC CPSU and USSR Council of Ministers. For instance, commencement of the most important organizational measure of drafting the master schemes in all industries was to have been preceded by a thorough study of the plants and factories to be incorporated into the production associations. On that basis ministries were to prepare predraft opinions, but they did not all do this, nor was it done for all associations, and as a consequence particular enterprises were incorporated without sufficient justification. On the other hand, for the same reason certain industrial enterprises were not incorporated into associations at the proper time and later the makeup of the associations created had to be revised. There have been such cases in practically all industries.

More than that. The decree of the CC CPSU and USSR Council of Ministers provided that the associations should incorporate plants, factories and organizations regardless of their geographic location and departmental subordination. These aspects were not sufficiently worked on by the ministries, and the study of them was particularly poor in the USSR Ministry of Light Industry, the USSR Ministry of Food Industry, the USSR Ministry of Timber and Wood Processing Industry and the USSR Ministry of Construction Materials Industry. Nor was there the proper coordination with councils of ministers of union republics. As a result very many enterprises of similar character were left in one and the same area under the jurisdiction of both union-republic and also republic ministries.

Another circumstance that had an adverse effect is that the main administrations of ministries endeavored to preserve the previous subordination of enterprises. The result was that in a number of cases the associations incorporated plants and factories which had no mutual technological relations, and consequently some of the newly formed complexes proved to be artificial and unviable.

When we adopted the course of setting up the production associations, we naturally expected a substantial reduction in the number of plants and factories, especially very small ones. Yet even though this work has been going on for a number of years now, quite a few very small enterprises have still persisted in the industrial sector: as of 1 January of last year the number of plants and factories with no more than 200 workers represented 55 percent

of the total, and their share in the volume of production was only 9.5 percent. The highest number of very small enterprises is in local industry, the food industry, the meat and dairy industry, light industry, timbering and the fish industry, and the building materials industry. Moreover, while a large number of very small enterprises have been preserved in these industries, small associations with fewer than 500 workers have been created in them. In this situation these structural subdivisions can hardly be seriously regarded as production associations, as unified production-and-economic complexes based on the principles of industrial specialization and cooperation, nor can it be assumed that they will be able to take full advantage of the possibilities afforded by technical progress.

In a number of industries the growth rates of the volume of production and of labor productivity is lower in the production associations than for the industry as a whole, examples being the machinebuilding and chemical industries, which also indicates oversights committed when they were formed.

There is still another shortcoming that should be discussed. Many production units have retained juridical independence (approximately 45 percent), which is not a necessity, and in our view is a consequence of a psychological barrier that has still not been overcome. The point is that in some industries the associations have not allocated incentive funds and production development funds even to the large production units within them, nor have they taken pains to quickly correct the shortcomings of the organizational period. The directors of certain associations have not even established dependable relations with affiliated plants, which is adversely affecting the responsiveness of management.

These shortcomings are gradually being corrected, but only slowly, and this stands in the way of full utilization of all the advantages of the new form of management. On the whole we should note that the approval and implementation of the master scheme can be regarded as completion of a definite important stage in improvement of management of industrywide systems--the organizational stage. Indeed, there are still various things that have not been completed, there is much to be done. But the organizational foundation does exist, and there is also the experience of the associations ZIL [Moscow Motor Vehicle Plant imeni I. A. Likhachev], Svetlana, Bol'shevichka, the Leningrad Optical Power Tool Association, three times awarded the Order of Lenin, and others, which one can look upon as a model of fundamental restructuring of production on the basis of industrial specialization and concentration.

The second stage, that of drafting programs for development and retooling of industries on the basis of the new production associations, is now beginning. Implementation of the master schemes makes it possible for every ministry and department to set up a system of management that will guarantee faster retooling of production. Relying on the master management scheme that has been approved and using the materials of the long-range program for the industry's future development, the ministry can determine which ways offer the most optimum solution of the question of meeting the needs of the economy for the products in question.

How do we see this work in practical terms? It is obvious that the upcoming tasks of each of the subindustries and of every all-union industrial association (VPO) should first be formulated. On that basis the VPO outlines measures toward specialization of production associations and plants, determining the minimum list of products in relation to optimum volumes of output. On that basis assignments are set for the coming planning period for each production-economic complex concerning the output of specific types of products and attainment of certain technical-and-economic indicators along with maximum utilization of the fixed productive capital already created. Projections of the development of the production associations, whose responsibility it is to meet the needs of the national economy for the specific products, are worked out on the basis of those assignments. These projections should make provision for the most rational use of existing fixed productive capital thanks to retooling and the creation of a unified production-economic complex from the individual plants that have been incorporated into the production association. It may, of course, be necessary in this connection to amend the solutions outlined in the master scheme, the makeup of the production associations, their number, and the number and makeup of all-union industrial associations.

Thus in the new stage the errors committed in preparing the master schemes are to be corrected. But this is not the only important thing, nor the most important. The master schemes create the organizational foundation for retooling of the newly formed structural subdivisions and for shaping very large and up-to-date production-economic complexes furnished with progressive technology in all sectors of the economy. This is the first important step toward fulfillment of the task set at the 24th CPSU Congress: altering the form of production by creating large production associations in all industries.

Practical experience shows that in the beginning many production associations formed in accordance with the approved master scheme are production associations in name alone. No important qualitative changes have yet taken place in them, and the plants and factories making them up are in general continuing to operate in the old way. The point is that the principal advantages can be obtained from their creation only after consistent implementation of measures to specialize and concentrate principal and auxiliary production and to centralize functions and the relevant staff services. To that end projections of the development of the production associations should be drafted in all industries; moreover, a differentiated approach should be taken to each of them, and each should have its own specific projection of development.

As work continues, it should be firmly understood that the production association is a new formation which has a fundamentally different importance that is not comparable with a mere aggregate of plants and factories. This is a new production-economic complex which incorporates not only plants, factories, mines or construction organizations and a computer center guaranteeing that the management of production is on an up-to-date organizational

and technical level. It is precisely the creation of this complex that is the principal goal of the projection of development, and one of the principal tasks in drawing up this projection is to seek out the most optimum variant for use of existing fixed capital thanks to its specialization, the concentration of production and, if necessary, by changing the configuration of individual plants and factories that have become part of the association. The projection should make provision for specialization and concentration not only of the principal production activity, but also of auxiliary production and for their retooling and reconstruction on the basis of the new functions of each of them within the association. There is also a need to project the introduction of up-to-date production technology, the modernization and replacement of equipment, full mechanization and automation, the most complete and efficient use of raw materials, supplies and equipment, the centralization of technical services, transportation and communications, of planning, accounting and reporting, of capital construction and capital repair, and so on. All of this should ensure a substantial rise in the labor productivity of the workers.

Experience in setting up associations shows the absolute need for the functions of the main enterprise and affiliates to be clearly delineated in the preparation of the projection of their development. The main enterprise performs centralized functions for purposes of normal distribution of work among the production units and the association as a whole and outside organizations. The production units perform similar functions for themselves internally and are connected to the main plant (factory) by a unified system (transportation, supply and tools). Moreover, the affiliates retain certain functions of management and accordingly the subdivisions that perform them.

For machinebuilding, for example, the association Moscow Motor Vehicle Plant imeni Likhachev is the typical (and obviously the most optimum) type of production association in the context of mass production. Aside from the main plants, it consists of 15 affiliates--specialized enterprises producing and delivering to the main plant castings, forgings, stampings, assemblies and units, and certain plants which produce and deliver a finished product according to the plan of the association. The scale of the production association is optimal if the plants and factories making it up work mainly to produce the end product and are thus organically connected to the main plant.

In the coal industry production associations are being created within the framework of the former coal combine. They include mines, beneficiation mills, repair plants, project planning and minebuilding organizations responsible for operational construction, all types of transportation, and warehouse management--totaling some 60-75 independent entities to be managed. This is a very large production-economic complex, one that requires a workable organization and an astute combination of centralization with the initiative of production units.

It is very important that principal attention in improving the organization of management in the industry be paid not so much to the principal production operation--coal mining, where in general the existing organizational forms are in line with the tasks of the present, as to auxiliary production--the servicing of production, transportation, and so on. As for the mines themselves, the practice here is to set up one consolidated mine on the basis of several small ones.

This approach is not accidental. The use of mechanized stoping complexes and other large-scale deep-mining equipment, the need to assemble and disassemble this equipment at the proper time, to organize the work of repairing it, of setting it up and of storing it necessitate the organization of specialized subdivisions. For example, in the association Karagandaugol' a specialized mine assembly administration was set up to ensure normal operation of the mechanized complex. Introduction of up-to-date machinery consequently has made it possible to speed up the processes of assembly, disassembly and repair of units, to improve the quality of these processes, to shorten the time they require and to lengthen the time the complexes stay in operation. Centralization of these operations has ensured that they are conducted in accordance with the established norms, has raised labor productivity, and has yielded a high economic benefit. The association's experiment should be utilized in preparing the standard projection for development of production associations in the coal industry.

In the association Vorkutaugol' the functions of reconstruction and development, which previously were the responsibility of two construction administrations, have been centralized, as have the appropriations (limity) for project survey work. This measure has made it possible to reduce the scattering of funds over numerous projects and to put production capacities into operation more rapidly. The centralization of repair and servicing of stationary installations in a specialized subdivision has improved the quality of repair and has made it possible to get repairs done within the allowed period of time.

In the association Voroshilovgradugol' the entire activity of material and technical supply has been centralized, as has motor transport, and certain staff services have been centralized. This has reduced the number of workers, the number of trucks needed has decreased by 130, and the production cost of coal has dropped.

Bookkeeping and financial supervision, payroll work, quality control, legal services, personnel training, medium-term and long-range planning, and analysis of production-economic activity have been fully centralized in all production associations. In our view the USSR Ministry of Coal Industry is also on the right road in adhering consistently to the principles of production specialization and concentration in setting up associations. This will help it to complete preparation of the standard projection of development of production associations in a very short time and then to use it as the basis for preparing specific projections for each of them.

In ferrous and nonferrous metallurgy the associations are being set up in exemplary fashion according to the same principle. It seems to us that it would be advisable to use the experience of the UCSR Ministry of Coal Industry in other industries as well.

The projection of the association's development must unfailingly take into account the need to establish long-term direct relations with suppliers and consumers and the conclusion of long-term business contracts for delivery of products on the basis of reference figures and direct relations organized in a planned way. Performance of those contracts should be taken into account in evaluating the association's activity.

The projection should be worked out on the basis of the program for development and retooling of the subindustry and industry and also a thorough study of the national economy's need for specific products and of trends in the change of the product's technical parameters and the prospects for its sale on domestic and foreign markets. The specialization of production associations within the limits of the subindustry is thereby ensured.

Taking into account the orientation toward end results, a completely accurate determination should be made of the quantities of products the association will produce and the conditions under which they will be delivered to consumers, the size of production capacities that are to be put into operation when the projection is completed and at intermediate times, the period for attaining rated production capacities and technical-and-economic indicators, the size of contributions that will be made to the budget without injury to the normal activity of the association, including expansion of production as called for by the plan. Indicators of the organizational, technical and economic development of the association, of its efficiency, and so on, are also determined.

If conditions allow, the projection of the production association's development should be worked out not just in one version, but in two or three, they should be examined, and the most effective one chosen not only from the economic standpoint, but also from the organizational, technical and social standpoints.

Effectiveness in improving management is determined first of all as the result of retooling and reconstruction, modernization and replacement of present equipment with more progressive equipment. It is manifested in a rise in the technical level of production and the product produced, in creation of stable and lasting conditions for planned introduction of the necessary changes in production engineering and technology, in replacement of existing equipment and application of new equipment, in the use of inventions and discoveries, and also in their practical application. It is equally important to determine in the projection the efficiency to be achieved by using new forms and methods in the organization of production, of work and of management engendered as a result of adoption of new equipment and technology, rationalization of work processes, and combination of planned management with the work initiative of the masses.

Finally, the projection should reflect the social benefit to be obtained through planned implementation of measures to protect the environment, to create healthful working conditions at every work station, to free people of heavy, monotonous and uninteresting work, to carry out preventive measures in the field of public health, to improve the organization of food service, the adequacy of children's institutions, the supply of housing and all forms of services, and so on. In the final analysis all of this tends to raise the quantitative and qualitative indicators of the association's performance. These measures, of course, require certain expenditures, but previously the expenditures for social measures incurred at the separate enterprises were not ordinarily taken into account.

It is obvious that in future one must calculate not only the efficiency of production and the saving on capital investments, but also outlays for social needs to determine the economic efficiency of improvement of management and of carrying out the development projections of the production associations.

That is not all. In determining the economic efficiency of carrying out a set of measures involving retooling and reconstruction on the scale of production associations it should be taken into account that projections make provision for replenishment of technical gear and adoption of organizational and social measures which were not feasible at all under the conditions of the separate plants and factories. This means that outlays for the retooling and reconstruction of the production-economic complex proved to be relatively larger than the corresponding one-time outlays at the separate enterprises, and this needs to be taken into account in project planning. In other words, in determining the economic efficiency anticipated as a result of creating the production associations one should thoroughly analyze the calculations and establish the level of costs charged to measures whose performance results from the higher requirements imposed on large production-economic complexes.

Thus the projections of the development of the production associations, which utilize all the advantages of production specialization and concentration, are needed above all to bring about their radical retooling and reconstruction. The approved projection is the basis for inclusion in the state plan of capital investments and contract work for specific associations. These projections should take the place of similar ones prepared for individual plants and factories before they became part of the production associations, since they no longer are in line with the new tasks. After all, in the subdivisions of the association changes ordinarily take place in the volume of operations, specialization is being carried out there, and in a number of cases their configuration may change altogether in connection with the transition to production of a different product.

The development projections are also needed for optimum and purposive utilization of resources intended for these purposes. Definite efforts are required to perform this task. The projections should first of all be worked

out in all sectors of the economy so that the total volume of capital investments to carry them out can be determined. It is also indispensable to know whether it is possible to carry out the projections within periods of time set forth in construction time standards, to include work to be done in the given planning period in the 5-year and long-range plans, and to ensure retooling and reconstruction on the basis of the necessary up-to-date equipment as provided for in the projections.

There is still another factor related to preparation of the projections of the development of the associations we should dwell on. They should consistently embody the principle of centralized management of technical subdivisions, production, transportation, supply, sales and product quality. All transactions with outside organizations are conducted by the association's central headquarters, and the enterprises making up the association should be granted the rights that ensure their normal activity.

The projection also defines the rated capacity and rated technical-and-economic indicators of the association, the organization of lasting direct relations involving delivery of the association's products to consumers and of material resources to the association, as well as a system for conclusion of long-term contracts. At the same time, the projection ought to provide for a system of planning, accounting, reporting and supervision that ensures a high level of competence in the drafting and fulfillment of the state plan or the specified list of products within the deadline stipulated in contracts, a wage system and a system for formation of economic incentive funds oriented toward the end results of operation.

In the drafting of projections of the development of the production associations maximum advantage should be taken of the experience of ZIL, LOMO, Svetlana, VAZ, Bol'shevichka and other large production associations as well as of project planning and scientific organizations acquired in recent decades. The point of departure here should be the fundamental proposition of the 25th party congress to the effect that the associations are a qualitatively new phenomenon in management of industrial production. They are not a mechanical joining together of enterprises, but a unified production-economic complex in which science and production are organically merged and specialization and cooperation are extensively developed.

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ECONOMIC DEVELOPMENT EFFICIENCY INDICATORS EXAMINED

Moscow IZVESTIYA AKADEMII NAUK SSSR--SERIYA EKONOMICHESKAYA in Russian No 3, May-Jun 79 pp 15-25

[Article by V. P. Loginov and M. N. Sidorov]

[Text] The article examines the problems of improving the measurements and planned management of the efficiency of social production. A case is made for comprehensive study of efficiency from the standpoint of all the principal stages in the process of reproduction of the social product, fixed capital and labor resources. An analysis is made of factors in the changing efficiency of the RSFSR's economic development in the 1960-1977 period. Specific directions for raising the efficiency of social production in our country are defined.

1. Efficiency Criteria and Indicators

In all stages of the construction of socialism attention was always paid to raising the efficiency of social production both from the standpoint of scientific treatment of the problem and also from the standpoint of maximum soundness and internal consistency of national economic plans. At the same time the augmented scale of economic development and the more emphatic orientation toward the use of intensive factors in economic growth impose new and higher requirements on efficiency methodology and on the set of practical steps to be taken in this field.

It was emphasized at the December (1977) and November (1978) plenums of the CC CPSU that the general reasons for the difficulties that exist is that the course toward intensification of the economy, toward higher production efficiency, and toward improved quality of performance have not been pursued consistently enough by planning and economic authorities, nor by enterprises.

Recently there has been a lively exchange of opinions in journals on the problems of determining the economic efficiency of social production. In most cases an effort was made to find a summary indicator which would give

maximum consideration to the costs of society and the results of its productive activity in a particular period. A majority of the specialists share the opinion that the "net product of society," the newly created value, i.e., the national income, is the indicator that best expresses the result of society's productive activity. As a matter of fact efficiency, as a qualitative characteristic of social production, should express the relationship between the result achieved, i.e., that amount of output (in physical and value terms) which goes for consumption and accumulation so as to expand production, on the one hand, and those costs which society has incurred. As for the content of social costs, the denominator of the summary indicator, opinions are divided among economists. A majority feels that the denominator in this formula should include expenditures of all production resources, i.e., of live and embodied labor, converted to some single unit of measurement.

In our view measuring the national income against the volume of resources used during the year shows only the efficiency of the latter's utilization--"resource" efficiency, without taking into account how well the result of production suits the needs of society.

However, in the final analysis the efficiency of operation of the entire system of social reproduction is expressed by the degree of satisfaction of society's needs or, more specifically, by the degree of attainment of those goals which society has set in a particular period. In the ideal case it would be desirable to have a criterion reflecting the degree of suitability of the volume and pattern of production to the level and pattern of needs. So long as we lack a formal criterion to perform that function, the best thing is to measure the efficiency of social production indirectly--by the per capita national income produced. In this case the dynamic behavior of efficiency will be indicated by this indicator's rate of change. In the economics literature it is used to measure the social productivity of labor. But it also has another meaning. Since the national income produced is the source from which society's socioeconomic needs are satisfied, the magnitude of this ratio indicates society's abilities to solve these problems.

It is ordinarily thought that the national income per worker in material production reflects only the efficiency of utilization of live labor. In order to avoid this allegedly "one-sided" assessment, resources of embodied labor (fixed and working capital) are also included in the denominator of the formula of the summary criterion for determination of production efficiency. But the national income per worker rises in direct proportion to the productivity of every unit of live labor, which in turn depends on the qualitative composition of the fixed and working capital used. That is why this ratio characterizes to a considerable degree the efficiency of utilization of the resources of embodied labor as well.

Attempts to devise a unified (summary) indicator of efficiency have yielded unsatisfactory results. First of all, all the factors affecting efficiency are not included in the formula: for example, outlays for worker education,

for environmental protection, and so on. Second, bringing together in one formula a large number of contradictory factors affecting efficiency tends to blur the economic meaning of the indicator obtained. Third, when resources are lumped together, it is not evident which of them are being satisfactorily utilized and which inadequately, which makes it difficult to discover potential for raising production efficiency.

As a function of the specific way in which the indicator is devised, then, a particular factor in the change of efficiency will have a different "quantitative load" in shaping the general criterion, and that predetermines its absolute level and dynamics; the influence of each particular factor remains unknown.

Not infrequently the difference between "flows of resources" and "stocks or inventories" in the economy is not taken into account when summary indicators are devised. For example, the volume of wages paid during the year after adjustment with a conversion coefficient, is added to the volume of fixed productive capital accumulated in the economy over many years.

In our view it is most fruitful to study the rise of economic efficiency in the stages of the process of reproduction and to discover the principal factors affecting the indicator's absolute level and dynamics. The results of one stage in the process of reproduction may be a factor affecting the results of another stage. For example, the accumulation fund, which is viewed as the source of the investment-capital process, figures in turn as a factor in the growth of the national income in the stage of production.

On the whole we are talking about a comprehensive analysis of efficiency in all stages of the production process--from the utilization of natural resources to production of a product (intermediate and final) and its consumption, including the efficiency of scientific-technical progress, the management and organization of production, and the utilization and distribution of labor resources, fixed capital and capital investments.

The specific degree of utilization of productive resources raises or lowers the productivity of social labor, but does not fully correspond to it. Theoretically one can contemplate a situation in which the utilization of fixed capital in time might be uneven when the level of automation of production is very high and a huge amount of fixed capital is concentrated in the hands of a single worker: specific types of equipment will be utilized to a greater degree than others. In this case we can hardly speak of low production efficiency. In the extensive type of expanded reproduction, when an ever greater quantity of productive resources is drawn into economic circulation, utilization of the latter cannot in general be uniform and equally efficient in all sectors and at all enterprises because of the technological peculiarities of production, its specialization, and the patterns of distribution (and redistribution) of resources. That is why we seem to observe two tendencies--a growing economy of live labor and a lag in the output obtained from material resources. The lower the ratio of the quantity of live

labor to the quantity of the means of production it sets in motion, the more difficult it is to achieve a faster rate of turnover and renewal of those means of production and, consequently, an improvement in their utilization.

As we have said, the level of costs must always be taken into account in evaluating efficiency, since it expresses the relationship between costs and benefits. With respect to labor productivity resulting from investments in technical improvement of production, the costs incurred result in a certain level of the capital-worker ratio. If outlays to increase and technically improve capital stood in a one-to-one relationship to the rise of the productivity of live labor, the problem of combining resources in the denominator of the efficiency formula would not exist. But this is not the case for the following reasons:

- i. given the varying composition of capital, its technical level and condition will have a varying influence on the growth of labor productivity;
- ii. frequently the value assigned to capital does not correspond to its actual technical level;
- iii. there are peculiarities in the formation of the composition and value of capital from region to region and from sector to sector. Moreover, given the scarcity of manpower, which is becoming increasingly acute, the saturation of production with capital is frequently accompanied by a deterioration in its utilization unless the number of jobs corresponds to the number of workers. A change in the limit of saturation of production with capital can ensue only as a result of scientific-technical progress, which brings about a change in the relationship between the outlays for the assets used and their performance characteristics.

Attempts to link this dependence between capital and live labor to a unified summary indicator of economic efficiency have had the sole result that capital has been taken into account only as expenditures of resources of a particular type, without taking into account their impact on the productivity of live labor and consequently on the size of the newly created value. Yet it is precisely this that is decisive and that needs to be expressed in the summary indicator. Nor does a simple addition of the productivity of social labor to the imputed productivity of capital make it possible to discover the internal interrelationship between the capital-worker ratio and the productivity of live labor; thus the magnitude of the summary efficiency indicator increases mainly by virtue of the rise of the productivity of live labor, whereas the resulting influence of the growing value of capital is negligible or altogether negative.

In the present stage of economic development the national income is increasing mainly by virtue of labor productivity, which depends in turn on the rise of the capital-worker ratio and the level of the output-capital ratio. The latter two factors register both extensive expansion of the productive plant and also scientific-technical progress, i.e., the process of intensive development.

If the output-capital ratio shows a tendency to decline, as is now occurring in the economy, then labor productivity, which depends in turn on the capital-worker ratio, has to be increased substantially in order to maintain high economic growth rates. However, as shown above, there is an economic limit on the rise in the capital-worker ratio which, if passed, brings about a disproportion between the number of jobs and the number of workers. That disproportion causes in turn a further deterioration in the utilization of equipment and, as a consequence, a drop in the output-capital ratio. The result seems to be a vicious cycle in which the cause becomes the consequence and vice versa.

That is why it is necessary to stabilize and raise the output-capital ratio by introducing more progressive equipment and technology, which sharply raises labor productivity and accordingly output--in larger proportion than the rise in the value of equipment.

In the study of the efficiency of social production, then, the principal attention, as we have already said, should be paid not so much to construction of a summary indicator as to analysis of the relation between costs and benefits in each stage of the process of reproduction and at the level of the national economy as a whole. The first step in this direction should be an analysis of the factors involved in the changing relationship between costs and benefits and specifically in the changing relationship between the growth rates of the productivity of live labor and the capital-worker ratio, between the growth rates of the national income produced and its "cost intensiveness," i.e., materials intensiveness, capital intensiveness and labor intensiveness.

In our view this kind of analysis is more constructive, since it not only shows the degree of utilization of the particular types of productive resources (live labor, fixed capital, materials), which is important in and of itself, but it also makes it possible to outline measures to improve utilization of each of them. In a summary indicator one can see only the overall magnitude (coefficient) of efficiency, and there is no unraveling of the causes of its upward or downward movement. Its need lies in the study of the dynamics of efficiency, international comparisons, development of a planned national-economic norm, and so on.

In any case, then, the problem lies not only in devising a new indicator, but also in paying greater attention to the indicators we already know. Their analysis is in need of qualitative improvement, and their role in justifying the most effective strategies in the national-economic plan should be enhanced. The indicators we are referring to are the productivity of social labor, the efficiency of utilization of capital, the output-capital ratio, materials intensiveness, etc.

Dynamic Behavior of Indicators of Efficiency in the Economic Development of the RSFSR

In 1977 TsENII [Central Economics Research Institute of RSFSR Gosplan] analyzed the efficiency of development of the entire economy and of its most important sectors in the RSFSR in the 1960-1975 period in order to discover potential for raising that efficiency. The research was based on the factor-by-factor analysis of the efficiency of utilization of particular types of resources (live labor, material resources and capital investments alone, fixed capital, and so on) mentioned above, along with analysis of the influence of structural shifts and changes in regional proportions. The calculations showed that the economic development of the RSFSR was characterized in that period by a stable growth (2.2-fold) of the per capita national income. The productivity of social labor, calculated as the ratio of the national income produced to the work force in material production, increased 2.35-fold in the 15 years. The second indicator grew more than the first because of the progressive process of a rise of employment in the nonproductive sphere.

At the same time the capital-labor ratio increased in a larger proportion (3.1-fold). As a result the ratio of the growth of labor productivity to the growth of the capital-labor ratio, in spite of sizable fluctuations from year to year, dropped from 0.72 in 1960 to 0.54 in 1975, i.e., by one-fourth, and shows a stable tendency to continue this decrease. This means that fitting out production with equipment was not being accompanied by a corresponding growth of labor productivity.

Against the background of a constant rise in the efficiency of utilization of live labor as a result of its rising productivity in the RSFSR economy, just as in the USSR economy, we observe a drop in the efficiency of utilization of productive resources, fixed productive capital in particular. One of the most important indicators of efficiency--the output-capital ratio--dropped over the period under consideration, though in certain years we observe a certain slowing down of this process. The drop of the output-capital ratio began in 1962 and was particularly sharp (relative to the previous year) in 1963, 1965, 1969, 1975, i.e., in years when the harvest was poor. In certain periods this indicator experiences a relative growth. In 1967, for example, a year that was a very good one for the economy, and in 1970.

The Ninth Five-Year Plan was on the whole characterized by a drop in the output-capital ratio, except in 1973, when it experienced a certain growth by comparison with 1972, which was an extremely poor year. The annual fluctuations of the output-capital ratio are explained partly by the unevenness in the activation of capital assets from year to year within the 5-year period.

Calculations show that the drop in the output-capital ratio is the principal factor inhibiting the rise of labor productivity in the national income. For instance, if the capital intensiveness of production had not risen in

the Ninth Five-Year Plan, then the national income in 1975 might have been 15.4 percent higher than it actually was. In other words, if the ruble invested in fixed productive capital in 1975 yielded a return at the 1970 level, 15.4 kopecks of net output would have been produced per ruble of fixed productive capital throughout the economy in 1975.

In the 1970-1975 period the principal factor in the growth of net output in the economy was the rise of labor productivity by virtue of the rise in the capital-labor ratio.

But the rise in the capital-labor ratio in recent years has led to an ever smaller return in the form of the rise of labor productivity, as indicated by the dynamics of the ratio of the growth rates of labor productivity and those of the capital-worker ratio. In 1976 this ratio continued to deteriorate and stood at 0.45, as compared to 0.54 in 1975.

Is there a conclusion that can be drawn about the dropping efficiency of social production when we use a unified indicator to compare the efficiency of utilization of resources of live and embodied labor? It seems to us wrong to suppose that it can. From the standpoint of the principal criterion of the efficiency of social production, i.e., correspondence between the level of development of the economic system to the degree of satisfaction of society's material and cultural needs, the efficiency of economic development is rising continuously. All of us are also familiar with the figures indicating the growth of the economic potential, the national wealth, the level of living, achievements in the field of environmental protection, the ever greater quantity of natural resources being drawn into economic circulation, and so on. Consequently, the deterioration of the level of utilization of material resources and chiefly of fixed productive capital is only one of the processes taking place in the economy, processes which characterize the efficiency of social production only when taken in combination.

There are various reasons for this phenomenon. They extend over a broad range of economic, scientific-technical and organizational problems. In a number of sectors there are special reasons for the unfavorable dynamics of resource utilization related to the specific nature of the sector, but all sectors and the national economy as a whole are affected by a number of general adverse factors, among which we need to single out the following.

First of all--the gradual deterioration of the quality of the mineral raw materials base of industry, the transition to exploitation of poorer and less accessible deposits. To this we should add the influence of the reorientation of the extractive industries toward exploitation of deposits located in the little developed regions of Siberia, the Far East and the North, which substantially increases the costs of extraction and the costs of shipping raw materials, fuel and energy to the principal consumers, located in the country's European zone. For instance, in the RSFSR coal industry the average working depth in deep mines increased from 188 to 281 meters between 1960 and 1975, the volume of overburden to be stripped per

1,000 tons of coal mined increased from 3,191 to 4,398 cubic meters, the relative share of mines containing gas increased from 60.5 to 73.2 percent, including an increase from 20.8 to 38.3 percent of above-category mines containing gas. In the iron mining industry the average iron contained in the raw ore mined dropped from 44.5 to 36.3 percent over the 15-year period (1961-1975), and as a result the consumption of raw ore per ton of commercial ore increased from 1.34 to 1.91 tons in that time. Given the relatively high share of the extractive industries in the industrial sector, the adverse factors affecting these industries have a strong influence on the economy as a whole. The share of material costs in the value of industrial output is also rising, as it is in the gross social product as well, and the rise of socially necessary expenditures for the extraction and shipment of fuel, raw materials and energy is still not being offset by the saving on live labor.

In spite of the economy's substantial reorientation toward intensification, in the Ninth Five-Year Plan the role of extensive processes was still great. Maintaining high rates of economic growth so as to solve society's socioeconomic problems was largely achieved by increasing the volume of capital construction, and this in turn was accompanied by an increase in the number of construction projects, which created ever greater difficulties in furnishing them manpower, materials and equipment, and brought about a lengthening of construction time and a slowing down of activation of production facilities and attainment of their rated capacity. For instance, in the coal industry the average construction time of new mines increased from 12.9 to 14.4 years between 1966 and 1975, and reconstruction time increased from 8.6 to 10.1. The inevitable lag in the investment process of the benefit resulting from the larger scale of capital investments has been having an ever greater impact on the output-capital ratio and capital intensiveness of social production. The faster growth rates of construction work have in turn intensified the shortage of labor resources in the economy, and consequently the shift coefficient of the operation of equipment has dropped at existing enterprises. The bulk of equipment manufactured and imported has gone to enterprises newly put into operation, which has slowed down the rates of renewal of the productive plant at existing enterprises.

The process of renewal of fixed capital in the economy seems at first to be yielding a benefit. In 1976 new assets created in the period between 1971 and 1975 comprised 33 percent of the fixed productive capital in the industrial sector of the RSFSR. But the bulk of these assets represent the capital of new enterprises. Renewal of existing assets is taking place slowly. In 1976 the coefficient of retirement of assets because of dilapidation and wear was only 1.5 percent, while the coefficient of activation of new assets was 8.6 percent.* This means that the process of "accumulation" of capital is still predominant in the economy, not the process of their renewal. This is also indicated by the fact that almost half of depreciation deductions

* "Narodnoye khozyaystvo RSFSR za 60 let" [Sixty-Year History of the RSFSR Economy], Moscow, Statistika, 1977, pp 52, 53.

for replacement is being used to augment productive capital, but not to replace those assets. Moreover, in recent years this share has showed a tendency to rise. This process has the result that there is a constant increase in the economy of the mass of equipment that is physically suitable, but is obsolescent, does not come up to the present-day technical level and is not capable of a sharp rise of labor productivity and an increase in the output-capital ratio.

The course toward technical reconstruction of existing enterprises as the basis of investment policy in the country was adopted in the decisions of the 24th and 25th CPSU congresses. However, the term "reconstruction" is often being applied at the present time not only to expansion of enterprises, but also to new construction. For instance, in 1975, according to the data of TsENII, the relative share of capital investments for reconstruction and retooling in the industrial sector under republic jurisdiction amounted to only 7.3 percent, while the share of investments for reconstruction involving expansion of production area was 46.8 percent.

In the 1960-1976 period there were substantial structural changes in social production. Because of the need to speed up scientific-technical progress, to solve socioeconomic problems, the need to strengthen the material and technical base of agriculture, and to optimize the fuel balance, the capital-intensive and materials-intensive industries (electric power, chemical and petrochemical, petroleum and gas) grew at the fastest rates in that period. By comparison with the average indicator for industry, the level of capital intensiveness is now 528 percent in the electric power industry, 111.5 percent in the chemical and petrochemical industries, and 179.7 percent in the fuel industry. Even within particular industries the growth of the most progressive production operations is involving a rise in capital intensiveness of the industry as a whole. For example, in the complex consisting of the timber and lumber industry, the woodworking industry and the paper industry the production of the end product has been developing at a faster pace (cellulose, paper, cardboard, particleboard, etc.), and that has involved a growth of capital investments in that production which has the highest capital intensiveness. A similar process is taking place in the food industry, where expansion of the assortment and improvement of the quality of foodstuffs necessitates introduction of progressive new technology and new organization of up-to-date production operations. Thus objective processes taking place in the economy and manifested in a change in the pattern of industry and relationships among individual production operations have tended to raise the level of capital intensiveness of social production.

3. Improving the Planning and Analysis of Production Efficiency

To improve the utilization of productive resources and to achieve a further and faster rise in the productivity of social labor, it would be wise to work out a set of measures covering the problems of improving the planned management of the economy, speeding up scientific-technical progress, improving the organizational structure of sectors and industries, raising labor

and planning discipline, combating losses, economic incentives to encourage production and utilization of all economic levers of the socialist economy (bank credit, prices, profit, the charge on assets and resources, ceilings on the use of capital investments, labor resources, fuel, raw materials and supplies).

It is not possible within the space of one article to examine all these questions in detail. We will therefore dwell on the most important ones, those which in our view have to be solved first.

At the December (1977) Plenum of the CC CPSU it was stressed that "the plan is the principal instrument for conducting the party's economic policy." In order to enhance the role of plans, it is necessary to "properly distribute funds among sectors and industries,... concentrate human and physical resources ... on the most important problems within the sector or industry and between them,... discover those specific units where the maximum rapid benefit can be obtained at the price of minimum cost."*

To solve these problems it would be best for the national-economic plans of sectors and industries, associations and enterprises to include indicators of some aspect of the rate of efficiency of utilization of productive resources, above all such indicators as the output-capital ratio, the growth of profit resulting from reduction of production cost, the saving from displacement of personnel thanks to mechanization, etc. Production plans and plans for adoption of new equipment and technology should be joined together to comprise a unified plan, rather than to figure merely as sections of the plan with responsibility for fulfillment variously assigned. The economic benefit, which serves only as an illustration in justifying plans, should become an economic indicator with the force of directive, a planning category subject to a standard. But this cannot be done without a simultaneous intensification of all the work on scientific methods related to the problem of efficiency in the country, without orienting preplanning studies toward seeking out unused potential for economic growth. At the present time meanwhile there is little work being done in the field of improvement of the forms, tables and indicators of the balances of the national economy, especially the planning balance and forecasting balance, which are indispensable to determining the most rational ways of future improvement of the principal proportions in the national economy, to balancing value and physical proportions, and to linking the volume and composition of retail sales and the money appropriated for capital investments with the materials and equipment destined for capital construction. There still is not sufficiently straightforward coordination between the quantitative indicators of economic development and indicators of the efficiency of the economy's development. Practitioners do not have at present scientific recommendations concerning the best combination of centralized economic management with the economic independence of production units.

* PRAVDA, 19 December 1977.

The efforts of many of the country's economic research centers have to be concentrated in order to draft sound recommendations on raising the efficiency of economic development. Unfortunately, there is no clear topic plan to coordinate even the work being done by the research institutes of Gosplan in the union republics.

In 1977 USSR Gosplan, the State Committee for Labor and Social Problems and the USSR Academy of Sciences approved a method of determining the economic efficiency of utilization of new technology, inventions and efficiency proposals in the economy; this was an important step in improvement of the planning and practical utilization of scientific-technical progress. Methodological guidelines for planning the benefit of new technology in the context of the peculiarities of a specific sector or industry are being worked out in sectors and industries on the basis of that method. When plans are being compiled, then, it has become possible to determine the expected (planned) size of the benefit from introduction of equipment and the influence of technical improvement of production on the final indicators of economic activity. There is good reason to speed up the process of practical application of these methodological principles in planning.

There is one other substantial difficulty along the way to achievement of these measures; this is the defects in the present system of recordkeeping and reporting concerning the operation of equipment. At enterprises no record is ordinarily kept of outlays for current and medium-sized repairs, of expenditures of fuel and energy for specific models of machines. As a result it is often impossible to compare the outlays for new equipment and machines being replaced, i.e., to determine the actual benefit of the new equipment, and without that it is impossible, of course, to establish the planned size of the benefit and its impact on the enterprise's final indicators. Consequently, along with the introduction of the new methodological principles, it is indispensable to improve the system of recordkeeping on the costs of operating equipment at enterprises, which will also make it possible to improve the economic justification of wholesale prices of new models of machines and to check the authenticity of the performance benefit assumed when prices are set.

The conduct of a unified technical policy in retooling sectors and industries and production operations, the transition to introduction of systems of machines instead of individual units, which presupposes that machine-building ministries will synchronize completion times for the various units, their technical parameters, the conditions for their repair and technical servicing by adopting standard designs and standards and by standardizing machine assemblies and parts, as well as enhanced responsibility on the part of the equipment manufacturer for the completeness of delivery, installation and adjustment of the equipment at the premises of the consumer, and the transition to manufacturer servicing of especially sophisticated and expensive equipment are measures important to speeding up application of the achievements of scientific-technical progress in the economy, the need for which was stated in the decisions of the 25th CPSU Congress.

Two interdependent processes are now taking place in production engineering and technology: first of all, equipment itself is undergoing improvement, and second, the operating parameters of individual units in a system of machines are becoming more interdependent. Failure to take either of these processes into account in planning results in incomplete utilization of the entire technological system as a whole, which is quickly reflected in the output-capital ratio and other indicators of economic performance. Since that is so, the output of particular types of equipment manufactured by different departments for operating within a system of machines as its separate components--for example, of excavators and heavy-load dump trucks, of tractors and the agricultural machines attached to them, of forging and pressing machines and metal-cutting machine tools, and so on--should be planned to fit in with dates for development of the designs, for plant testing and for initial and series production, with the number of types of equipment to be applied in the economy, with the productivity (capacity) of units and with their service life.

In the creation and introduction of new machines and equipment great importance should be given to plans for the introduction of new technology, which is one of the sections of the enterprise's technical, industrial and financial plan. But little attention is still being paid to compiling this section and to its detailed substantiation. The main thing for the enterprise is the output plan, and the plan for introduction of new technology is given a secondary role. The reason for this is that enterprises frequently do not see the long-range prospects for their own development and the development of related industries.

Current planning is still predominant in the system of planning work. Yet the plan governing introduction of new equipment and new technology can only be a long-range plan and should be closely related to the profit-loss indicators of enterprise performance. This cannot be done within the limits of 1 year because of the well-known share of indefiniteness in the development of science and technology. It is only in the framework of a 5-year or 10-year plan that the enterprise and industry can determine the possible dates for completion of scientific projects and the change in the list of products produced; only in that framework can they achieve a closer link between the economic benefit of introducing a new product and such indicators as profit, production cost, and transfers to the economic incentive fund.

Improving the mechanism for economic operation is an important factor in raising the efficiency of economic development. The present mechanism of economic operation took shape in its main features during the prewar period. These basic planning principles have hardly changed at all even today, though the economy itself has undergone tremendous qualitative changes. It is becoming extraordinarily complex and there has been an extraordinary increase in the number of production and nonproductive units and of interrelations among them. Given this situation, the forms of planning need a thorough restructuring to meet the new requirements of economic management with respect to the most efficient economic development.

The 25th CPSU Congress set forth the demand that the allocation of capital investments should be tied to a specific growth of output. But the present mechanism of economic operations places a number of obstacles on that path. The first of them is that capital investments are "gratis" for sectors and industries.

The principle of the "gratis nature" of capital investments objectively encourages sectors and industries to constantly expand the number of projects under construction, i.e., pushes them on the extensive road of development. Unfortunately, this tendency has not yet been overcome and is resulting in an understaffing of enterprises, a drop in the shift coefficient, an increase in the amount of partial completion of construction, longer construction times, and so on.

In practice the allocation of capital investments to sectors and industries does not depend on the principal results of their performance, for example, on the amount of profit earned or the rise of labor productivity achieved. When the amount of capital investments to be allocated without reimbursement does not depend on the results of economic performance, this engenders a corresponding attitude toward the funds allocated.

Beginning in 1970, as we know, the USSR Ministry of Instrumentmaking, Automation Equipment and Control Systems made the transition to the pay-as-you-go principle. Problems of a specific kind arose: the setting of price levels on products produced and determination of rates of transfers from profit. But these are after all secondary problems; the main thing was done--the industry became actively involved in comparing benefits and costs of its economic development and also took long-range prospects into account, which is the basis for stable growth of production efficiency.

It would be wise to extend this experience to other ministries as well, setting clear rates of transfers from the profit earned and making the size of capital investments allocated a function of the principal resulting indicators of the industry's development, thereby replacing gratis financing of capital investments with credit financing.

We have dwelled on only some of the most important problems of raising the efficiency of economic development. There are many of them, and they are all closely bound up with one another. Solving them requires serious and coordinated efforts on the part of researchers and practitioners.

The economic potential embodied in the socialist mode of production is inexhaustible. The task is to find the best ways of utilizing it.

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ECONOMIC GROWTH MODELS PRESENTED

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[Article by D. Chernikov, acting sector head of the Scientific Research Institute of Economics of USSR Gosplan: "Models Linking Growth Rates to Factors in Economic Growth"]

[Text] The factor approach to the planning and forecasting of rates of economic development is based on the proposition of the Marxist-Leninist theory of reproduction to the effect that the growth of the total mass of material wealth is determined by the magnitude of the means of production and labor power applied. Simulation of the interrelations between economic growth rates and factors presupposes that relations are set up that make it possible to quantitatively measure expenditures of live and embodied labor against the results of production and also to discover patterns in relations between the expenditures themselves.

The method of combining the factors of production, which is embodied in the technology, is the basis of the relations between factors and growth rates. Every technology is characterized by a certain relationship between live and embodied labor that makes it possible to attain the given level of labor productivity. The specific form of the expression given to this interrelationship is arrived at by testing various methodological functions and by comparing them from the standpoint of approximation of empirical data, simplicity, statistical reliability and the economic meaningfulness of the estimates obtained.

Numerous computations made both for the sphere of material production as a whole and also for its branches show that the interrelationship between levels of labor productivity and the capital-worker ratio is described sufficiently well by the following exponential function

$$P = AB^Y, \quad (1)$$

in which P--labor productivity;

A--scale factor used to adjust indicators to the same dimensionality;

B--capital-worker ratio;

γ --elasticity coefficient of labor productivity with respect to the capital-worker ratio (showing the number of percentage points of growth of labor productivity when the capital-worker ratio rises 1 percent).

This function can be expressed as follows in average annual growth rates

$$p = \gamma b,$$

in which p and b--growth rates of labor productivity and the capital-worker ratio, respectively.

The dependency of labor productivity on the capital-worker ratio, obtained for the sphere of material production in the USSR for the 1961-1975 period (Figure 1), serves as a support in simulating the interrelations between economic growth rates and factors. Various approaches to determining the influence of the factors of production on performance and to delineation of the forms of technical progress and types of economic growth are worked out on the basis of this function and its modifications.

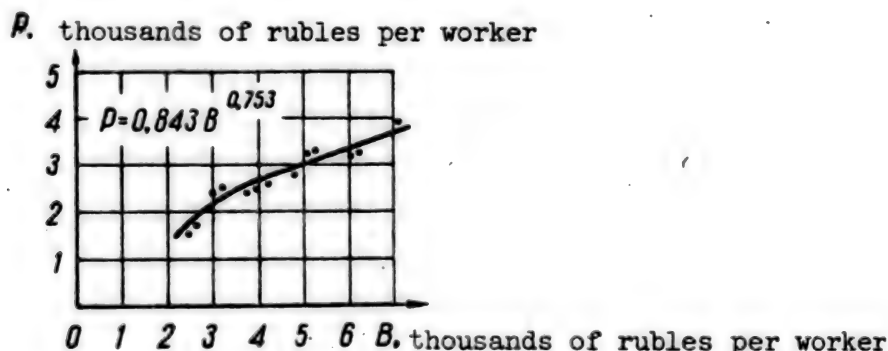


Figure 1

One of the best known forms of the functions based on dependence (1) are production functions of the Cobb-Douglas type. The transition from dependence (1) to the simplest of them is made for $0 < \gamma < 1$:

$$Y = AK^\gamma L^{1-\gamma}, \quad (2)$$

or

$$Y = AK^\alpha L^\beta \text{ when } \alpha + \beta = 1,$$

in which Y--national income produced;

K--fixed productive capital;

L--number of persons employed in material production;

$\gamma = \alpha$ --elasticity coefficient of output relative to fixed productive capital;

$(1 - \gamma) = \beta$ --elasticity coefficient of output relative to expenditures of live labor.

A characteristic peculiarity of this type (2) of production function is that the sum of the elasticity parameters relative to the resources of production is equal to unity. When the volume of fixed productive capital and the number of employees rise 1 percent, output also rises 1 percent. Proponents of production functions of the Cobb-Douglas type, then, say that a relationship in the form (2) reflects only extensive expansion of production (growth of the result in proportion to growth of expenditures of resources). Attempts are then made to put in dynamic terms the function of form (2) in order to reflect both the extensive and intensive components of economic growth within the limits of the set of production functions of the Cobb-Douglas type.

The production function of the Cobb-Douglas type is being modernized in two directions. One is to introduce a third term into the production function that depends on time and is interpreted as a measure of the effect of the intensive component on the process of economic growth. The other is to renounce the condition that the sum of the elasticity parameters of the production function is equal to unity, whereupon additional normative suppositions are used to make the transition to separating the extensive and intensive components of economic growth. Transformation of the production function in the form (2) on the basis of the first of these directions results in a function of the following form when the change in the rate of technical progress is uniform

$$Y = AK\mu L^{1-\mu} e^{\lambda t}, \quad (3)$$

in which μ , $(1 - \mu)$ --elasticity coefficients of output relative to extensive growth of fixed productive capital and labor resources, respectively;

λ --parameter of the incremental total efficiency of the factors of production (rates of technical progress);

e --base of natural logarithms;

t --time.

When this method is applied the entire remainder of the national income not dependent upon the purely quantitative growth of fixed productive capital and labor resources is credited to the share of the growth of the total efficiency of the factors of production. Thus it is assumed that the parameter λ is accumulating all the qualitative changes taking place in the economy: technological innovations, higher manpower skills, a higher level of knowledge and improved organization of production.

The meaning of technical progress in the production function (3) differs from the generally accepted meaning, since it is not related to replacement of live labor by embodied labor, and its rate does not coincide with the growth rate of labor productivity. A peculiarity of production function (3) is that technical progress bringing about the growth of the total efficiency

of the factors of production is exogenous in nature and depends only on the flow of time.

We will give the results of a verification of production function (3) on the basis of actual data for the sphere of material production in the USSR in the 1961-1975 period. In Figure 2 the empirical and theoretical relationships derived from (3) are given for the dependence of the growth rate of labor productivity on the growth rate of the capital-worker ratio for the USSR sphere of material production in the 1961-1975 period, i.e.,

$$p = \mu b + \lambda. \quad (4)$$

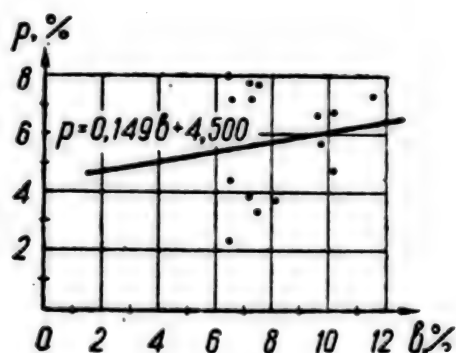


Figure 2

As we see, the figures plotted in Figure 2 indicate insufficient stability of the linear form of correlation between the indicators being considered. It is difficult on the basis of the data obtained to discover any sort of other stable form of correlation.

So, the approach to describing the interrelations between economic growth factors and performance which we have been discussing, an approach based on assigning technical progress exogenously, did not receive statistical confirmation.

The other direction in transformation of the production function of form (2) leads to a function in which $\alpha + \beta \neq 1$:

$$Y = AK^{\alpha}L^{\beta}. \quad (5)$$

It is a peculiarity of this production function that it cannot be directly reduced to a dependency of labor productivity on the capital-worker ratio. Production function (5) is built on the assumption that the resources of production have an independent impact on the results of economic growth, i.e., its point of departure is to acknowledge the homogeneity of the factors of production and the absence of an interrelationship between the processes of reproduction of labor resources and fixed productive capital. In

the framework of this approach an attempt is made to determine the relationship between the extensive and intensive components of economic growth. For example, when there are extensive and intensive factors $\alpha + \beta > 1$ and the quantity $\alpha + \beta - 1$ characterizes the proportion of the effect of the intensive component on the process of economic growth.

The introduction of additional concepts of a normative nature makes it possible to obtain on the basis of the production function a more precise delineation of the extensive and intensive components of economic growth and to reduce this function indirectly to a dependence of labor productivity on the capital-worker ratio.*

Following the transformation of production function (5) we obtain the following dependence of labor productivity on the capital-worker ratio:

$$P = AB\mu e^{\lambda t},$$

in which $\mu = \alpha/(\alpha + \beta)$; $\lambda = ([\alpha + \beta - 1]/[\alpha + \beta])y$.

In this relation technical progress is no longer autonomous, as it was in the production function of form (3), but is materialized, yet even in this case its rate differs from the growth rate of labor productivity.

We will present the results of an experimental verification of the applicability of production function (5) in describing the real process of economic growth. Table 1 shows the estimates we obtained of the parameters α and β for the USSR sphere of material production for sliding 10-year periods and as a whole for the 1961-1975 period.

Table 1

Periods (sliding 10-year periods)	Parameter	
	α	β
1961-1970	0.492	1.332
1962-1971	0.464	1.451
1963-1972	0.423	1.535
1964-1973	0.765	-0.027
1965-1974	0.835	-0.462
1966-1975	0.726	0.299
1961-1975 as a whole	0.702	0.412

An analysis of the parameters of production function (5) calculated by the method of least squares, shows that for relatively stable values of α the parameter β experiences extremely strong fluctuations. Moreover, for some

* See: A. I. Anchishkin, "Prognozirovaniye rosta sotsialisticheskoy ekonomiki" [Forecasting the Growth of a Socialist Economy], Moscow, Ekonomika, 1973, pp 19, 220 and 251.

of the sliding 10-year period $\beta < 0$, which makes no sense from the economic standpoint, since it indicates a negative contribution of labor resources to the process of economic growth. The attempt to achieve stability of the parameter β for longer sliding periods (15-year and 20-year) for the actual data pertaining to the 1951-1975 period was also unsuccessful.

Thus an economically meaningful analysis of the production function in the form (5) is difficult, and though the extensive and intensive components can theoretically be distinguished, in practical terms the delineation is not reliable. We can conclude therefrom that the hypothesis of the independence of the effect of the factors of production, on which the production function of the form (5) is based, is not statistically confirmed.

Consequently, both the traditional Cobb-Douglas production function in the form (2) and also its modification in the forms (3) and (5) fail to afford a sufficiently accurate description of the real process of economic growth. This compels us to examine critically the principal features of these forms of the relationships.

In our opinion the conception of production functions of the Cobb-Douglas type contains a number of far-reaching simplifications which greatly restrict the field in which it can be applied. For example, the production function in form (2) has traditionally been regarded as one which reflected only extensive expansion of production, and the parameters γ and $(1 - \gamma)$ were viewed as extensive characteristics of the contribution of embodied and live labor to the growth of the resulting indicator (national income or the final social product). In our view the elasticity parameter γ includes both extensive and also intensive characteristics. As a matter of fact, as the parameter γ changes (assuming $0 < \gamma < 1$) there is still a 1-percent growth of the resulting indicator (national income or final social product) for a 1-percent growth of fixed productive capital and labor resources, just as before. But the elasticity coefficient of labor productivity relative to the capital-worker ratio changes, the decrease of the output-capital ratio slows down or speeds up. This means that the relationship between the intensive and extensive components of economic growth is changing, which is not detected in the traditional interpretation of the production function in the form (2).

When the transition is made from the relation in the form (1) to the production function in the form (2) it is assumed that this function is economically interpretable in the interval $0 < \gamma < 1$. Let us examine the soundness of the limits put on variation of the parameter γ . Its lower limit is economically sound, since negative values of γ are permitted only when the level of labor productivity is dropping as a consequence of a rise in the capital-worker ratio. Theoretical and statistical studies show that this situation is quite unlikely. The upper limit of the parameter γ restricts the possibility of devising a production function in the form (2) on the basis of the relation (1) because of the condition that the capital-worker ratio must grow faster than labor productivity. Consequently, the production

function in form (2) describes dependencies typical only of the capital-intensive form of technical progress.

In the production function of form (3) technical progress resulting in a growth of the parameter of the gross efficiency of the factors of production turns out not to be related to the process of saturation of live labor with embodied labor, but is an exogenous factor drawn in from outside. Thus in this modification of the Cobb-Douglas production function we have an underestimation of the role of fixed productive capital as a material vehicle of technical progress.

In the production function that takes the form (5) it is postulated that the processes of reproduction of fixed productive capital and of labor resources are autonomous. At the same time it is obvious that only labor resources are a relatively independent factor of production, while fixed productive capital, as a factor internal to the economic system, does not possess that kind of autonomy.

Consequently, a critical examination of the propositions on which the conception of production functions of the Cobb-Douglas type is based gives rise to the need of making certain adjustments in it and of finding methods of eliminating its inherent defects.

We will set up a function based on the dependence between levels of labor productivity and the capital-worker ratio within whose limits one can reflect both the capital-intensive and also capital-saving form of technical progress and distribute the growth of output between the extensive and intensive components.

We take production function (3) as our base equation. We transform it as follows:

$$P = AB\mu e^{\lambda t}. \quad (6)$$

To counteract the traditional assumption that technical progress is independent of fixed productive capital, we assume that it is manifested in the replacement of live labor by embodied labor. As a matter of fact, all major shifts in technological methods of combining the factors of production are inevitably related to new capital investments, which are the material vehicle of technical progress. We therefore relate technical progress to the growth of the capital-worker ratio taking place on the basis of new capital investments. Then we obtain from (6)

$$P = A\bar{B}\mu \quad (7)$$

in which the indicator $\bar{B} = Be^{mt}$ registers not only the increase of the capital-worker ratio, but also the rate of technical progress $m = \lambda/\mu$.

Since the nature of technical progress implies not only a tendency toward a rise in the volume of fixed productive capital relative to the number of persons employed in material production, but also a rise in labor productivity, we assume $m = p$. Thus $\lambda = \mu p$, and equation (6) takes the form:

$$P = A[BePt]^\mu. \quad (8)$$

We will represent the last equation in average annual growth rates, taking into account $p = \gamma b$:

$$P = \mu b + \mu \gamma b. \quad (9)$$

Equation (9) can be transformed:

$$p/b = \mu(1 + \gamma),$$

and since

$$p/b = \gamma, \text{ then } \mu = \gamma/(1 + \gamma),$$

and therefore

$$\gamma = \mu/(1 - \mu).$$

If we take into account the equality (1) and assume $\gamma = \mu/(1 - \mu)$ function (9) can be represented as $P = AB\mu/(1-\mu)$.

We refer to the function obtained as the function of technical progress, having thus confirmed its difference from production functions of the Cobb-Douglas type. We will examine the peculiarities of the function of the form (6-9).

In equations of this type the parameter μ is defined for $\gamma > 0$ in the interval $0 < \mu < 1$, and γ along the entire positive semiaxis $0 < \gamma < +\infty$, which makes it possible to examine within the limits of this function the patterns of economic growth that are inherent in the capital-intensive and capital-saving forms of technical progress. The relationship between the forms of technical progress is one of the most important characteristics of the process of expanded reproduction.

When the strain on the balance of the country's labor resources is increasing, economic growth is increasingly achieved by raising labor productivity. The basis of the rise of labor productivity is technical progress, which occurs in both the capital-intensive and also capital-saving forms. The relationship between the forms of technical progress is shaped by the dynamics of labor productivity and the capital-worker ratio. When the growth rates of labor productivity are faster than those of the capital-worker ratio, the capital-saving form of technical progress predominates. And if labor productivity is growing more slowly than the capital-worker ratio, then the

capital-intensive form of technical progress is predominant. The parameter μ is the criterion characterizing the particular form of technical progress: the capital-intensive form of technical progress is when $0 < \mu < 0.5$; the capital-neutral form is when $\mu = 0.5$; and the capital-saving form is when $0.5 < \mu < 1$.

We checked the function of technical progress of the form (6-9) against statistical data for the sphere of material production in the USSR in the 1961-1975 period. The results of the calculations for sliding 10-year periods and for the period as a whole are shown in Table 2.

Table 2

Periods (sliding 10-year periods)	Parameter	
	μ	$\lambda = \mu p$
1961-1970	0.419	2.19
1962-1971	0.438	2.39
1963-1972	0.452	2.53
1964-1973	0.453	2.52
1965-1974	0.448	2.45
1966-1975	0.437	2.33
1961-1975 as a whole	0.439	2.50

The values obtained for the parameters μ and λ are very stable. Statistically reliable results were obtained for all the periods considered, which makes it possible to make an analysis of the patterns of economic growth by 5-year periods. The figures needed for that are given in Table 3.

Table 3

Sectors of Economy	Share of Capital-Saving Form in Total Rate of Technical Progress For 5-Year Periods			
	1961-1975	1961-1965	1966-1970	1971-1975
Sphere of material production	43.6	36.8	47.7	39.4
Industry	48.5	37.2	51.0	48.7
Construction	25.3	16.7	27.1	27.3
Agriculture	21.9	23.3	23.5	2.2
Transportation and communications	53.9	53.0	55.9	49.6
Trade, food service industry, procurements and material and technical supply	32.7	4.4	32.8	38.8

In the USSR sphere of material production and its principal sectors in the 1961-1975 period (except for the industrial sector in the years of the Eighth Five-Year Plan and transportation and communications in the 1961-1970 period) the capital-intensive form of technical progress was predominant.

Throughout the sixties the share of the capital-saving form was increasing in the sphere of material production and its principal sectors, while the share of the capital-intensive form in the total rate of technical progress was decreasing. In the 1971-1975 period the share of the capital-saving form of technical progress decreased in the production sphere, industry, agriculture and transportation and communications. In agriculture this drop in the share of the capital-saving form was most noticeable and caused it to disappear almost entirely. In trade, the food service industry, procurements and material and technical supply, as well as in construction, the value of the capital-saving form rose slightly.

The sectors of the economy differed not only in the dynamics of the shares of the capital-saving and capital-intensive forms of technical progress, but also in their absolute value. For instance, whereas in industry and in transportation and communications the share of the capital-saving form of technical progress steadily exceeded the average level for the national economy throughout the period under review, in construction and agriculture, trade, the food service industry and material and technical supply it was considerably smaller.

The predominance of one or the other form of technical progress depends on the tasks confronted in a given period of the country's economic development. The capital-intensive form of technical progress is closely bound up with the stage of primary mechanization of production and is predominant in the situation when live labor has still been replaced only slightly by embodied labor, and as a consequence the relative share of manual labor is high.

The capital-saving form of technical progress is related to the stage of intensification of production and becomes predominant as a rule only after sufficient saturation of live labor by embodied labor has been achieved.

Because a broad range of problems in mechanizing labor-intensive operations has been solved in the USSR economy, the scale of the economy of live labor resulting from additional expenditures of means of production is high at the present time. Potential for further mechanization is especially large in construction and agriculture. We should also note the insufficient relative share of those capital investments which are committed to the replacement of outdated equipment, to the modernization and reconstruction of existing production facilities and to the renewal of fixed capital. These are in fact the reasons for the sizable relative share of the capital-intensive form of technical progress.

Delineation of the capital-intensive and capital-saving forms of technical progress is the basis for distinguishing the share of intensive factors in the process of economic growth. But since the share of intensive factors is being determined in the growth of output (national income produced) rather than in the growth of labor productivity, then in addition to the indicators characterizing the capital-intensive and capital-saving forms of technical

progress, a purely quantitative growth of employment in material production is included among the necessary factors.

Table 4

Sectors of Economy	Share of Intensive Factors in Growth of National Income Produced			
	For 5-Year Periods			
	1961-1975	1961-1965	1966-1970	1971-1975
Sphere of material production	36.9	33.8	41.0	30.2
Industry	34.5	22.7	38.4	40.0
Construction	11.2	10.8	11.6	15.2
Agriculture*	--	--	--	8.3
Transportation and communications	43.2	30.5	58.6	30.6
Trade, food service industry, procurements and material and technical supply	10.7	2.5	8.7	16.9

* The figures are not given for agriculture in the 1961-1970 period since technical progress in that sector during that period by and large had no impact on the growth of output, but offset the outflow of labor resources. In a situation when technical progress does not promote economic growth, but replaces labor resources withdrawn, it makes no sense to determine the share of intensive factors in the growth of output.

In the seventies technical progress had a greater impact on the growth of output of agricultural products; in the 1971-1975 period the relative share of this type of progress increased to 84.6 percent. As a consequence a basis emerged for determining the share of intensive factors in the process of economic growth.

The intensive type of economic growth is related to the capital-saving form of technical progress, since an economy of both live labor and also embodied labor is typical of it, while the extensive type of economic growth is related to the capital-intensive form of technical progress and a purely quantitative increase in the number of persons employed. The process of intensification is highly diverse and is variously manifested in different stages of economic development. Moreover, as a rule we find that the share of intensive factors in the sphere of material production does not coincide with their share in its most important sectors (Table 4).

In the 1961-1975 period (except for transportation and communications in the years of the Eighth Five-Year Plan) the share of intensive factors of economic growth was less than half in the sphere of material production of the USSR and in its most important sectors. The sixties were characterized by greater intensification in all sectors of the sphere of material production. In the 1971-1975 period the share of intensive factors continued to rise in

industry, trade, the food service industry, construction, procurements and material and technical supply. It showed a tendency to decline in the sphere of material production. The reason for the sharp drop in the share of intensive factors for the economy as a whole in the years of the Ninth Five-Year Plan was the drop in the rate of technical progress in transportation and communications and the slower rate of growth of the efficiency of agricultural production because of the extremely unfavorable weather conditions. The results of the calculations obtained on the basis of the functions of technical progress of the type (6-9) are in line with theoretical conceptions of the development of the Soviet economy in that period of time.

The functions of technical progress (6-9) make it possible to determine the dependence of the growth rate of labor productivity resulting from the capital-intensive form of technical progress and the growth rate of labor productivity resulting from the capital-saving form of technical progress on the growth rate of the capital-worker ratio. The analysis we made showed that an exponential dependence of the growth rate of labor productivity resulting from the capital-intensive form of technical progress ($p - \lambda$) on the growth rate of the capital-worker ratio is typical of all sectors of the economy:

$$p - \lambda = a_1 b^{a_2}, \quad (10)$$

in which a_1 and a_2 --parameters determined by the method of least squares.

The function of technical progress (10) is a generalization of the production function (4). The latter can be obtained from the dependence (10) when $a_2 = 1$.

For all sectors of the economy we obtained estimates of the parameter $a_2 < 1$. Consequently, the growth $p - \lambda$ as the parameter b increases gradually dies down, and does not increase along a straight line, as follows from production function (4).

Since $p - \lambda = \mu b$ in function (10), a possibility is afforded of determining the dependency of the parameter μ on the growth rate of the capital-labor ratio:

$$\mu = a_1 b^{a_2-1} \text{ when } a_2 < 1. \quad (11)$$

The dependence of the growth rate of labor productivity resulting from the capital-saving form of technical progress (λ) on the growth rate of the capital-worker ratio (b) is not so uniform in the sectors of the economy. We will give three cases.

In the sector "Transportation and communications" we find that the parameter λ increases linearly as a function of the growth (b). This indicates that in this sector intensification of production is mainly related to new fixed capital put into service. It follows that the higher the growth rate of the capital-labor ratio, the higher will be the parameter λ .

In the sectors "Agriculture," "Construction," and "Trade, food service industry, procurements and material and technical supply," the dependence of the parameter λ on the growth rate of the capital-worker ratio is absent because in those sectors the principal resources for intensification of production lie in the domain of improved utilization of existing fixed productive capital.

In the sector "Industry" the parameter λ decreases in direct proportion to the rise in the growth rate of the capital-worker ratio. This form of correlation can be explained by the fact that industry is typified by a specific lag--the period required to bring fixed productive capital up to rated capacity. For that reason a stepping up of the growth rate of the capital-worker ratio, which results in a growth of the share of fixed productive capital not yielding a return during the period before they have attained rated capacity, has an adverse effect on the dynamics of the parameter characterizing the intensification of production.

At the level of the national economy the dependence of the parameter λ on the growth rate of the capital-worker ratio does not exist.

Thus for the sphere of material production the parameter of the incremental efficiency of social production is typically independent of the growth rate of the capital-worker ratio, but this is no longer because of its being exogenously assigned, as is usually the case with production functions of the Cobb-Douglas type, but because the parameter λ at the level of the national economy is the resultant of sectoral tendencies in different directions.

The separate analysis we made of the dependencies $p - \lambda = f(b)$ and $\lambda = \phi(b)$ allows us to represent the function of technical progress (9) as follows:

i. for the sphere of material production, agriculture, construction, trade, food service industry, procurements, and material and technical supply--as

$$p = a_1 b^{a_2 - 1} + \lambda;$$

ii. for industry--as

$$p = a_1 b^{a_2 - 1} + (a_3 - a_4)b;$$

iii. for transportation and communications--as

$$p = a_1 b^{a_2 - 1} + (a_3 + a_4)b.$$

Functions of technical progress based on the hypothesis $\lambda = \mu p$ make it possible to determine three or four parameters reliably for the sectors of the economy, while production functions of the Cobb-Douglas form (3) and (5) do not guarantee the requisite reliability of estimates even for two parameters.

So, functions of technical progress based on the assumption $\lambda = \mu p$ improve the stability of the parameters being evaluated and make it possible to increase their number, to use this mathematical apparatus for both short-term and long-range calculations, and to supply a straightforward economic interpretation of the results obtained.

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USSR GOSPLAN DEPUTY CHAIRMAN BACHURIN DISCUSSES PLANNING

Socialist Competition in Plans

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 25 Apr 79 p 2

[Text] Despite the familiarity of their content, there are pages in the history of our country which we like to read over and over again because the value of their lessons is so exceptional. Among these pages are those containing the first five-year plan for the development of the national economy -- the initial Soviet five-year plan. Our people were filled with faith and enthusiasm when they adopted the plan for the construction of the foundation of socialism. "Fulfill the counter plan!" "Fulfill the five-year plan in four years!" Thus the industrial and agricultural workers responded to the appeals of the 16th Party Conference to develop a massive socialist competition to fulfill and overfulfill plan targets.

Today, after a lapse of half a century, socialist competition has assumed qualitatively new features, and truly has been accepted by all of the people. The campaign for full realization of the potential of mature socialism, the acceleration of scientific and technical progress, and the undiminished growth in the effectiveness of production and the quality of work occupies the center of attention of the participants in the competition. In his welcoming remarks to the attendees at a recent all-union scientific and practical

conference in Leningrad on the theme:
"Socialist competition as a movement for a communistic attitude toward labor is a powerful means of developing the creative activity of the masses and the training of the new man," comrade L. I. Brezhnev stressed that in these patriotic movements: "...the party envisions not only a powerful lever to multiply the successes of labor and the accelerated solutions to large-scale economic problems, but also as an important means for the communistic training of the masses."

The further development and enhancement of the effectiveness of competition is dependent in large measure on the deepening of the coordination of its organization with the mechanism of the socialist economic operation. This problem was discussed in detail at the all-union scientific and practical conference. The discussion specifically addressed the particular types of improvement in the planned management of the economy that would ensure closer coordination between the planning system and the new, progressive creative initiatives of the workers and the labor collectives.

Such a formulation of the problem is clearly understandable. The formulation is stipulated by the new, more complicated goals for improving the management of the national economy that were discussed at the 25th party congress and at subsequent plenums of the CPSU Central Committee and in the pronouncements of comrade L. I. Brezhnev. The essence of the goals is in the need to improve substantially the content and methods of planning in forthcoming years. The highest priority will be given to the five-year plans to intensify the effects of the total economic system and socialist competition on the effectiveness of production and the quality of work.

While drawing up the plans for the fundamental directions in the economic and social development of the country during the periods to 1985 and 1990, USSR Gosplan is proceeding from the necessity to create economic and organizational conditions, as early as the 11th Five-Year Plan, for the enhancement of the role that the five-year plans will play in the proportioning and balancing of the total economy. In this connection, problems have arisen that require solutions, such as those of improving the methods of drawing up and balancing the plan for the five-year period in general as well as for each year individually, and of strengthening the economic and moral involvement and the responsibility of the ministries, associations, and

enterprises for the formulation and carrying out of optimum five-year plan tasks in terms of quantitative and qualitative indicators.

The substantial increase in the role of the five-year plan in total economic operations and the conversion of plan annual targets into primary orientations for the rate and proportion of reproduction and for the organization of the operation of each enterprise amount to difficult tasks. Their completion requires the reexamination of a series of established traditions in the management, planning, and methods of economic operations. These tasks create new problems in the organization of the socialist competition by requiring that the role of competition be intensified during the drawing up and implementation of stepped-up, optimum five-year plans. Counter planning is particularly significant here, since it is an important method for organizing the formulation and broad discussion of five-year plan projects by collectives of production associations and enterprises using control figures received from the ministries.

This approach does not weaken the effectiveness of the annual plans. These plans are called on to specify the goals of the five-year plans that were approved for the appropriate year and to supply the organizational and economic preconditions that are conducive to the successful fulfillment of the total five-year plan. The five-year plan thus, in reality, becomes the basic directive plan for the economic and social development of the country.

When the emphasis is placed on the fulfillment of the five-year plans, the continuous activity of fulfilling their targets is ensured. This has the advantage of overcoming the practice of formulating the annual plans on the basis of the "achieved level," which interferes with the full use of intraorganizational resources. New potential for increasing the effectiveness of cost accounting and economic and moral incentives consequently are uncovered. At the same time, the economic responsibility of the ministries, associations, and enterprises for the final performance in individual years and over the full five-year plan grows. It then becomes possible, on the one hand, to increase the self-dependence of sectorial ministries and associations in the drawing up and implementation of the annual plans, and, on the other hand, to raise the level of operational performance for the long-term planning of the national economy by USSR Gosplan, ministries, departments, and the councils of ministers of the union republics.

The proper combination of the drawing up and approval of plan targets "from above" and the formulation of plans by

enterprises and organizations "from below" is vital. The initiatives of the labor collectives and advanced know-how also should be given a full accounting in the plan. Socialist competition is called on to play a decisive role here. The task now consists of converting the competition into the primary method of organizing the planned work in production associations (enterprises) and to direct the competitors to the identification of deep resources for the further growth of production and the enhancement of its effectiveness. Preference should be given to those labor collectives that ensure the drafting and implementation of stepped-up five-year and annual plans.

The necessity for improvements in planning and competition is borne out by an analysis of the factual situation in the drawing up of counter plans in recent years. With the shift in 1978 to the new procedure of drafting counter plans and providing for their inclusion in the assignments of the state plans, the number of enterprises that adopted these plans decreased in comparison with 1977. Last year, 5,000 enterprises prepared counter plans relating to the five-year plan, while 2,400 enterprises prepared counter plans relating to the annual plan. This amounts to a total of 7,400 enterprises or 17 percent of the total number of industrial enterprises. However, the counter plans have changed and become more effective than they were in 1977 when 18,000 enterprises used them. The differences between the content of the counter plans within individual ministries have become substantial. The quotas for sale production in some of the ministries have reached 5 to 6 percent of the total volume, while in other ministries it is less than 1 to 2 percent.

The amount of attention paid in the counter plans to the indicators of production effectiveness are grossly inadequate. In 1979, several ministries generally failed to draft counter plans for labor production (Ministry of the Gas Industry, Ministry of Construction, Road and Municipal Machine Building, and Ministry of the Medical Industry) while others forecasted insignificant increases in production effectiveness. The proportion of increased production resulting from the rise in labor productivity in the plans for the current year amounts to approximately 80 percent, but according to the counter plans this figure was less than 60 percent.

Checks show that some collectives are merely adopting the counter plans as a formality, without substantially mobilizing internal resources. A lack of interest on the part of the collectives is one of the reasons for this. Other causes are shortcomings in planning practices and the permitted deviations between annual plans and the approved five-year plans.

L. I. Brezhnev stated at the 16th Congress of Trade Unions: "When the worker knows that his voice is being heard, ~~that he is~~ being counted, and that his thoughts actually are being taken into account during the drawing up of social and economic plans, then, and only then, will he feel that he is a true manager of production and of his own fate. It is here that political and production goals come together. One of the additional advantages of the counter plans is that they inherently allow the coordination of the active creativity of the workers with the total planning system. The initiative of the labor collectives, as it is expressed in the counter plans, will be implemented successfully when the plans are included in the obligatory indicators for fulfillment of the five-year and annual plans. In this case, the interests of the labor collectives closely merge with those of the state.

The ministries, departments, and the councils of ministers at the republic level must examine the projects in the counter plans of the associations and enterprises carefully, introduce the necessary amendments based on the demands of the national economy and the provision of material resources, and approve them according to established procedures. When drafting the counter plans, particular attention should be given to the proper allocation of the work force, the introduction of technically sound output quotas, the most complete use of production capacity, and the cost effective consumption of raw and finished materials, fuel, and electrical energy. In the final analysis, it is a matter of the most appropriate selection of indicators and criteria of evaluation which guide the competitors and facilitate their coordination with the mechanisms of cost accounting, economic incentives, and bonus systems.

Our party has adopted a policy of improving the final indicators that characterize the improvement of the national economic results of the operations of each enterprise and organization. Among these, high priority is attached to the indicator for the supply of goods from the specific product lists to consumers and the timely opening of newly constructed structures for enterprises and projects. These indicators respond not only to consumer interests (the buyers) but also to national economic interests. Intensification of attention to them promotes the balancing of the plan both at the national economic level, as well as on the level of each individual enterprise and association. It also must be kept in mind that the indicators for the supply of goods in physical terms and the introduction into operation of new capacity and fixed capital are closely aligned with the improvement of the economic ties and the strengthening of economic contracts. The improvement of their role in the economic system and in the organization of

socialist competition encourages the acceleration of capital turnover, the growth of the capital-output ratio, and the achievement of large productive output at minimal cost.

Nevertheless, according to data of the USSR Central Statistical Administration, plans for the delivery of goods from the specific products list are underfulfilled by many enterprises. There are various reasons for this. But one thing is clear, the only way to ensure the smooth flow of supply and production is through the efforts of all of the collectives, and not in isolation, but in cooperation both with associated organizations, the suppliers of raw and finished materials, customers, and the transportation workers. Consequently, the combined, mutually coordinated socialist obligations and the counter plans are becoming increasingly more significant factors in the mastering of the indicators for the delivery of goods in physical terms and the guaranteeing of the regular, smooth work of every collective. The broad shift to direct, steady economic links and the conclusion of long-term contracts while simultaneously strengthening the material and moral responsibility for the timely delivery of goods to consumers are highly significant. It is becoming a reliable precondition for the successful fulfillment of the five-year and annual plan assignments based on the indicators of production efficiency and increases in the effectiveness of competition.

Socialist Competition

Moscow EKONOMICHESKAYA GAZETA in Russian No 19, May 79 p 9

[Text] Planning always has been inseparably linked with socialist competition. V. I. Lenin envisioned the core of the management of the national economy in the planning process, and an authentic socialist method in competition for organizing the activity of labor collectives in the struggle to implement the plans for economic and social construction.

The State Committee for the Electrification of Russia plan, the initial long-term national economic plan in world practice, was drawn up under the leadership and direct participation of V. I. Lenin. Lenin's ideas on planning served as a scientific foundation for the formulation of the first five-year plan, the 50th anniversary of which is now being observed in cooperation with the sister countries. As with planning, socialist competition also has won world-wide recognition. Their inseparable linkage has been reemphasized forcibly in the decree of the

CPSU Central Committee: "On the 50th Anniversary of the first five-year plan for the development of the national economy of the USSR."

Growing Role of Five-Year Plans

In accordance with the main directions for the improvement of the economic system that were discussed at the 25th CPSU Congress, subsequent plenums of the CPSU Central Committee, and the talks of L. I. Brezhnev, the role of long-range plans in the development of the economic and organizational management of the operation of enterprises is growing.

While drafting plans for the fundamental directions of the economic and social development of the country for the periods through 1985 and 1990, USSR Gosplan is proceeding from the necessity to strengthen the scientific base in the balancing of long-range plans and to establish the economic and organizational conditions for the further enhancement of the role of the five-year plan in the proportional and balanced development of the whole economy during the 11th Five-Year Plan.

This is dictated by the growing scale of the socialist economy and the increase in the number of sectors, large enterprises, and territorial production complexes. It is critical both for the consistent implementation of the policy of accelerating scientific and technical progress and for increasing the efficiency of the production required for improvements in the intersectorial and interregional proportions, in the priority approach to the planning of capital investments, and in the stable and balanced economic links between enterprises, sectors, and regions.

The role of the five-year plan in the entire sphere of economic activity has increased dramatically. The conversion of the goals of the plans, which have been approved on a yearly basis, into the primary guides for the rate and proportion of reproduction and the organization of the operations of enterprises is a difficult task that requires the reexamination of certain entrenched traditions in the management, planning, and methods of economic operations. The task also poses new problems for the organization of socialist competition. The part played by competition in the drafting and implementation of stepped-up, optimum five-year plans needs to be strengthened. Competition in the structure of the counter plans should be expanded since it is an important method for organizing the development and extensive discussion of five-year plan projects by collectives of associations and enterprises based on the control figures obtained from the ministries.

Under such an approach, when the emphasis is placed on the five-year plans and their fulfillment and the continuous functioning of the goals of these plans is ensured, while the evaluation of the fulfillment of the five-year plans occurs using mounting results, the optimum organizational and economic conditions for systematic and proportional development can be achieved in practice, along with the maintenance of stable economic ties between enterprises. All of the factors for the growth of the production of social labor and the increase in the efficiency of the application of national economic resources as well as improvements in the removal of all types of bottlenecks and shortages can be influenced forcefully by the further enhancement of the role of the five-year plans and by improvements in their balancing.

Consequently, the task amounts to the implementation of socialist competition, particularly counter plans, and its conversion into a paramount form of organizing planned work in production associations (in enterprises), after having directed the competitors toward the identification of deep resources for the further growth of production and increases in its efficiency. Preference should be given to those labor collectives which will draw up and fulfill stepped-up five-year and annual plans.

Problems of Counter Planning

In 1978 and in the present year, in addition to the positive results there also has been a certain amount of shortcomings in the working up of counter plans by the enterprises and in the management of this activity by the ministries.

The number of enterprises adopting counter plans decreased in comparison with 1977 after the conversion in 1978 to the new procedure of developing counter plans and allowing for their inclusion in the targets of the state plans. Counter plans related to the five-year plan were used in 5,000 enterprises last year. They helped surpass by more than 3 billion rubles the goals set by the ministries for the realization of production. Counter plans related to the annual plan were adopted by 2,400 enterprises. Their fulfillment made it possible to exceed by 250 million rubles the initial targets of the ministries for the realization of production. Thus, counter plans were developed in the past year by 7,400 industrial enterprises, or 17 percent of the total number. The counter plans, of course, now have a different content. They are more efficient than they were in 1977 when they (over and above the annual plan) were adopted by 18,000 enterprises, or 41 percent of the total.

It is necessary to mention the extremely inadequate attention that is given in the counter plans to the indicators of the

efficiency of production. In 1979, some ministries generally did not use counter plans based on labor productivity (Ministry of the Gas Industry, Ministry of Construction, Road and Municipal Machine Building, and Ministry of the Medical Industry) and others only provided for a small increase in labor productivity. Competition in the structure of the counter plans is being influenced substantially by the existing shortcomings in planning and the permitted deviations in the annual plans from the approved five-year plans.

It is quite clear that when five-year plans for the economic and social development that contain a distribution of targets on an annual basis are used to the fullest extent possible as a fundamental form of planning and organizing the production and economic activity of enterprises, associations, and ministries it will become possible to increase substantially the effectiveness of competition during the drawing up and implementation of five-year plans. In the process, socialist competition should be developed widely not only between individual enterprises, but also between groups of associated enterprises and sectors that are connected by a unified technology, extensive cooperation, and combined production. It also would be advantageous if the significance of the personal five-year plans of workers and engineering and technical personnel was increased in the competition process.

This approach to the development of the structure and methods of competition will make it possible to identify and use productive reserves more completely and to direct the creative initiative of the workers to the formulation and implementation of solutions to large, complex problems associated with the technical, economic, and social development of enterprises and associations.

The enhancement of the role of the labor collectives in the drawing up and discussion of project plans was foreseen during the preparation of the decree on improving the planning process and strengthening of the effects of the economic system on efficiency and quality. The aim is to expand the authority of the enterprises in the formation and application of economic incentive funds and in the solving of other economic and financial problems. This expansion is in full agreement with the provisions of the USSR Constitution. At meetings of industrial and office workers and at regular production meetings, discussions are now being held simultaneously on five-year and current project plans for production associations and enterprises, and the suggestions from the workers are considered during the approval of the plans.

Reference Point -- Final Results

The importance and effectiveness of modern socialist competition to a large extent is a factor of the proper selection of the indicators and the evaluation criteria that are used to guide the competitors, and which facilitate their coordination with the system of cost accounting, economic incentives, and material and moral incentives. In accordance with the formulated economic strategy, our party will pursue a policy of improving those final indicators that signify the improvement of national economic results from the performance of individual enterprises and organizations. These are the indicators that are aimed at increasing the level of fulfillment of consumer demands and the effectiveness of production and the quality of work.

Paramount among the final production indicators adopted in the competition process is that of the supply of goods to consumers from the specific products list and the timely opening of completed structures for new enterprises and projects.

Data from the USSR Central Statistical Administration show that a large number of enterprises are underfulfilling plans for the supply of goods from the specific products list. The underfulfillment is caused by various factors including but not limited to the activities of the enterprises themselves. But it must be kept in mind that the widespread dissemination of the recommended approach to the evaluation of the performance of industrial enterprises, transportation, material and technical supply organizations, and other sectors is a primary condition at this point in time for the fuller and more timely satisfaction of the demands of the national economy and the population and for improving the role of the consumer by producing goods of the required assortment and quality and ensuring a proper tempo in the production and reciprocal delivery of goods.

It is abundantly clear that this problem can only be solved through the efforts of all of the enterprise collectives, and not just in isolation but in cooperation with associated enterprises, suppliers of raw and finished materials, consumers, and transportation workers. The cooperative, mutually coordinated socialist obligations and counter plans, therefore, are becoming an increasingly important factor in the timely supply of goods in physical terms and are guaranteeing the regular and smooth work performance of each collective.

One of the highest priorities and urgent tasks is to strengthen the effects of the total economic system, including planning, organization and management, economic levers and incentives, and various forms of socialist competition, on the improvement

of the application of labor resources and the growth of labor productivity. At the same time, this will aid in more effectively solving the problem of consolidating labor resources, which is a necessary precondition for raising the efficiency of labor and production.

Therefore, subsequent to supplying goods from the specific products list, the indicator of labor productivity must be transformed into a primary planning and evaluation indicator and a fundamental criterion for evaluating the effectiveness of the performance of each industrial enterprise, the transportation system, each construction project, and each sovkhoz and kolkhoz.

The strengthening of the economic system to raise the quality of all types of goods also will be a high priority. The quality of equipment and consumer goods must be improved substantially in the coming years. Related to this is the improvement of the quality of raw materials and construction materials, and their more cost effective use. The cited problems clearly will merit close attention during the 11th Five-Year Plan. A combined approach is necessary for the successful solution of these problems; consequently, it is necessary extensively to transfer the advanced know-how of enterprises in Moscow, Leningrad, L'vov, Sverdlovsk, and other cities and rayons, in which the system of complex quality control has been introduced.

The tasks that must be completed to improve the economic system and the methods for their implementation are dictated by the very necessities of life and the conditions for the development of the economy in the short term. They are in complete agreement with the economic strategy that was formulated at the 24th and 25th party congresses. There is also every reason to believe that they will be fulfilled. Nevertheless, to accomplish this much work is yet to be done, particularly by planning and operational organizations.

It is crucial that the enterprise collectives actively participate in the campaign for efficiency and quality now when the plans for the 11th Five-Year Plan are still being formulated, and that their counter plans allow for higher indicators (than those of the control figures that they will receive) for labor productivity and the quality of goods, the conservation of metals, fuels, and other types of raw and finished materials, and the enhancement of consumer goods and national economic production at relatively low current and one-time costs.

Socialist competition must be given more extensive development in the total application of the available potential for increasing production efficiency and the quality of work using

the experience of the leading enterprises during the 10th Five-Year Plan. The increased development of competition should promote the contemplated improvements in the plan indicators for economic and social development, as well as the criteria for evaluating the performance of enterprises and associations during the summing up of economic activity and the results of socialist competition.

Improvements in the organization of drawing up of the five-year and annual counter plans and the broader discussion of them by industrial workers, engineers and technical personnel, office workers, trade union committees, and other organizations will make it possible to use more extensively the deep reserves for the growth of production and its efficiency, and to increase the effectiveness and organizational role of socialist competition in the fulfillment of the economic assignments of the 10th Five-Year Plan and the new, 11th Five-Year Plan, which we are now in the process of drafting.

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BETTER PLANNING, MANAGEMENT OF AGRO-INDUSTRIAL COMPLEX DISCUSSED

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[Article by N. P. Fedorenko: "On Improving the Planning and Management of the Agro-Industrial Complex"]

[Text] The July (1978) Plenum of the CC CPSU defined the basic directions for the further development and increased efficiency of the country's agriculture and of the branches which provide for its industrialization, and the ways to achieve scientific and technological progress and to improve socio-economic relations in the village.

The problem of the further growth and increased efficiency of agricultural production is a difficult and overall problem. It embraces all of the spheres of social production and affects the vital interests of our entire society and of every Soviet person. The Communist Party has devoted unremitting attention to the development of agriculture at all of the stages of our country's historical path. Basing itself on the decisions of the July Plenum, the November (1978) Plenum of the CC CPSU decreed further measures to increase yields and the productivity of livestock and poultry, to increase the gross harvests of grain and other agricultural crops, to increase the production of meat, milk, eggs, and wool, and to fulfill the plans for the procurement of cropping and animal husbandry products. The plenum also demanded persistent work to eliminate losses and to ensure the safekeeping of agricultural output and to strengthen the material base for its storage and processing (L. I. Brezhnev, "Speech at the 27 November 1978 Plenum of the CC CPSU. Decree of the Plenum of the CC CPSU," Moscow, Politizdat, 1978, p 27).

The accomplishment of most (if not all) of the most important socio-economic tasks which face our society at the current stage of its development depends to a decisive extent upon the efficient development of the agrarian sector of our economy. At the present time the state is assigning around 27 percent of its total capital investments to agriculture and the branches directly connected with it. Under present conditions approximately three-fourths of our retail turnover in state and cooperative trade is accounted for by food, clothing, and footwear, that is, by those goods

which are produced basically from the output of agriculture [1, pp 356, 458-459].

The consistent realization of the party's agrarian policy which was worked out by the March (1965) Plenum of the CC CPSU has ensured a substantial upsurge in this vitally important branch of our economy. This has expressed itself, above all, in a strengthening of its material and technical base. During the past period fixed productive capital in the village has increased by 2.8 times and power capacities by 2.3 times [L. I. Brezhnev, "On the Further Development of USSR Agriculture. Report at the 3 July 1978 Plenum of the CC CPSU. Decree of the Plenum of the CC CPSU adopted on 4 July 1978," Moscow, Politizdat, 1978, p 6].

However, while giving their due to these unquestionable successes, it cannot but be seen that the return from expenditures in agriculture is still insufficient. Year after year the capital-intensiveness of a unit of increase in gross output increases, while return on capital, correspondingly, decreases. During the period when it was necessary to rapidly overcome agriculture's lagging behind other branches in the field of equipment and capital-labor ratio such tendencies were to a certain extent justified. But one cannot but be disturbed by the fact that the increase in the capital-labor ratio of agricultural production is being accompanied by an outstripping increase in production expenditures compared to the increase in the production of output. The cost of producing a unit of a number of types of agricultural output is increasing. We have to accomplish a further rapid development of agricultural production, but this does not mean that our successes have to be achieved at any cost.

Consequently, along with a further growth of agricultural output, especial attention should be given to increasing the efficiency of its production. "The task...of increasing the efficiency of agricultural production," L. I. Brezhnev emphasized at the July Plenum, "must, under current conditions, be placed in the forefront" [Ibid, p 32]. The importance of this problem is also connected with the fact that in the forthcoming period a sharp decrease in the growth of labor resources is expected. Their main consumer for the time being continues to be the agro-industrial complex (AIC). This is why the entire increase in the output of agriculture and of the AIC as a whole will have to be achieved solely on the basis of a rise in labor productivity. More than that, the agriculture of a number of areas will have to serve as a source for replenishing the labor power of other branches of the economy.

The problem of increasing the efficiency of agriculture has political, economic, social, scientific and technical, and other aspects. We shall touch upon only some of, as it seems to us, the key economic issues.

The first of them should probably be designated as the formation of the AIC which at the present time is objectively occurring under the influence of a deepening social division of labor. The AIC contains the branches

which supply agriculture with the means of production (sphere I), agriculture itself (sphere II), and the branches which have the task of procuring, transporting, storing, processing, and realizing agricultural output (sphere III).

However, the structure of the AIC which is being formed has not yet taken its final shape, and there is a lack of balance in the development of individual branches of the complex. The basic mass of the workers employed in the sphere of the AIC are being used as before in agriculture. They account for around two-thirds of the total number, while the production of industrial means of production for the village, and also the procurement, transportation, storage, processing, and realization of finished output made of agricultural raw materials are experiencing a shortage of labor power.

There has now developed a clear lagging in the development rates of the branches of spheres I and especially III of the AIC. Compared with the 7th Five-Year Plan, the amount of capital investments in agriculture during the 9th Five-Year Plan increased by 2.6 times, while the increase in light industry was 2.3 times, and in the food industry it was only 1.8 times. From 1970 through 1977 fixed productive capital in agriculture increased by 84 percent, while in light industry this increase was only 65 percent, and in the food industry--60 percent, including 36 percent in the sugar industry [1, pp 40, 133, 352-353].

The insufficient development of the branches which provide for the processing and storage of agricultural output is turning into substantial losses for society. An important share of certain cropping products for whose production enormous labor, material, and financial resources are expended perishes because their reliable storage and punctual processing is not being provided for. For example, the processing of sugar beet within 90 days after its procurement ensures an output of 14 to 15 kilograms of sugar from a quintal of roots. If, however, the processing period is drawn out to 150 days, the specific sugar output declines to 4 to 5 kilograms. There are also substantial reserves for increasing efficiency in, for example, the production, transportation, and use of mineral fertilizers.

The insufficient development of the branches which form sphere I of the AIC is resulting in a high level of labor expenditures in agriculture, above all, due to a lack of the machinery and equipment which is necessary for the overall mechanization of production processes. In addition, an optimal ratio between, for example, the number of tractors and the necessary sets of agricultural machinery is not being maintained. For this reason, such a first-class tractor as the K-701 is operating with unproductive and imperfect mounted implements. In addition, of the nearly 80 implements which it requires, there are less than 30. For this reason, the potential capacity, productivity, and estimated efficiency of the K-701 tractor is, in essence, not being realized.

There are also definite disproportions in agriculture itself. Thus, during the last 15 years the increase in capital expenditures for land improvement has substantially outstripped the increase in expenditures for the development of these lands with the result that the productivity of irrigated lands differs little in many areas from the productivity of dry lands.

The absence of normal conditions for storing equipment on a number of kolkhozs and sovkhozs; shortcomings in the quality and reliability of the equipment itself, a failure to comply with operations norms, and in certain cases insufficiently qualified mechanization specialists--all of this shortens the normed service life of agricultural machinery. As a result, a substantial proportion of the deliveries of agricultural equipment are assigned to replace equipment which has prematurely been written off. There is no necessity to explain what an enormous economy of social labor and capital investments could be yielded from the creation of elementary structures for the storage of machinery. The expenditures for the construction of such structures would be covered many times over by an economy of capital investments and resources for the production of agricultural equipment.

Thus, one of the central tasks in increasing efficiency is a substantiation of optimal development rates for the branches which are members of the AIC, a substantial improvement of its structure and of interbranch and branch proportions, and an efficient use of what has already been achieved or produced. In order to realize this task there have to be serious measures to improve the planning and management of agriculture and of the entire AIC. As is known, it was already stated in the Summary Report of the CC CPSU to the 25th Party Congress that in planning the development of agriculture and the branches connected with it we frequently come up against departmental disunity and that the time has come to ensure a single national economic approach to the development of the entire agro-industrial complex [Materials of the 25th Congress of the CPSU," Moscow, Politizdat, 1976, p 53]. At the present time decisions concerning the development of each of the branch elements of the AIC are frequently made independently of one another and partial branch tasks are advanced to the forefront, which frequently does not accord with the final goals of the complex. Under these conditions the distribution of capital investments and material and technical resources among the AIC branches is made difficult. The agro-industrial complex has to be regarded as an organically single whole in the structure of the socialist economy. Only well-directed management of the development of all of the branches of this complex will make it possible to avoid the disproportions which arise between its component elements and to orient their development toward their achievement of the final goal--a fuller satisfaction of society's needs for the foods and consumer goods which are produced from agricultural raw materials.

In order to overcome the shortcomings in the planned management of the AIC it is necessary to resolutely shift to special-purpose programmed planning

which orients all of the branches of the AIC toward an increase in the production of final output. Great assistance here can be provided by mathematical economic methods, including the solution of the problems of an optimization of the distribution of limited resources with a maximization of the expected effect. Existing experience shows that the use of these methods to solve the problems of specialization, siting, the rational use of the production apparatus, the transportation of output, and others makes it possible to achieve an economy of capital and operating expenditures of up to 20 percent compared with the traditional computation methods.

Historically, the methods of mathematical statistics were the first to be used in application to the economy of agriculture. Academician V. S. Nemchinov played an outstanding role in developing them for the solution of agrarian problems. The research performed by him in the field of analyzing the social structure of the Soviet village, of a sample measurement and forecast of yields, in the organization of statistical observations, and so forth [2] had a marked influence on the development of the science of economics. Today also statistical methods are widely used in analyzing the influence of natural-climatic and other factors on the productivity of agriculture, and so forth (See, for example, [3]).

As is noted above, the use of optimization models can yield a great benefit for the solution of the problems of increasing the efficiency of agricultural production and of the functioning of the AIC as a whole. Optimization models of the development and location of agriculture (See, for example, [4, 5]) make it possible to calculate (in a territorial breakdown) the structure of sown areas and the herds of agricultural livestock, the amounts of gross and commodity output, and the needs for the capital investments and labor and material resources which will ensure a minimization of adduced expenditures for the production of agricultural output of assigned amounts and structures (or a maximization of the production of output with assigned resource ceilings).

The differences in posing problems of this kind have to do chiefly with the method of inventorying the types of land resources, the amount and character of land improvement work, and the transformation of land; a detailization of the calculation of the needs for feed, fertilizers, and material resources; and structural limitations on sown areas which are the result of the requirements of agrotechnics, and also limitations on the production of gross or commodity output. One of the modifications of this kind of agricultural development optimization problem which was made in the All-Union Scientific Research Institute of Feeds of the USSR Ministry of Agriculture with regard to the experience of previous practical realizations has been included in the first stage of the automated production calculation system of USSR Gosplan.

Some of the ways in which the problems are posed are designed for the planning of individual subbranches of agriculture, in particular: grain

[4, 5 and others] with regard to the transportation expenditures during grain procurement; the growing and processing of cotton [6]; and the growing and processing of sugar beet [7 and others] including a determination during the solution process not only of harvest amounts, but also of harvest schedules in order to minimize sugar losses.

In order to increase the adequacy of the reflection of real production conditions models of the development of the agrarian subbranches are being proposed that take account of the possible damage to the economy as a whole and to agriculture itself from chemicalization, particularly from the use of pesticides and mineral fertilizers [8]. On the basis of the results of the calculations, more expensive, but less toxic pesticides prove to be economically more advantageous. Another direction is the calculation of accidental factors which occur as a result in unpredicted changes in weather conditions by means of the methods of stochastic programming.

Approaches to the mathematical economic modeling of the agro-industrial complex from the point of view of the single final goal of its functioning are receiving an intensive development [9, 10 and others]. The distinguishing feature of a model of this type is the direct coordination between the results in agriculture and the amount of material resources allocated for its development, and the distribution on this basis of capital investments among the branches which are members of the AIC. This type of model is being developed now jointly by the Central Institute of Mathematical Economics of the USSR Academy of Sciences and the Main Computing Center of Gosplan USSR. Numerous projects are being carried out in the field of modeling the individual subsystems of the agro-industrial complex, above all, regional ones [11-13, and others]. The singling out of regional AIC and the optimization of their structures has become an important direction of scientific research in republic economic institutes. The process of agro-industrial integration is leading to the appearance of new formations, particularly of enterprises, firms, and associations, which is demanding the development of methods for optimizing their internal structures and production programs.

Thus, the use of mathematical economic methods and models is becoming one of the important ways of accomplishing the task of increasing economic efficiency. There has to be a wider practical use of this powerful scientific apparatus by planning and management agencies at the various levels of the management of the agro-industrial complex.

An important condition for the realization of the special-purpose programmed approach is an improvement of the forms of the management of the AIC and this, in its turn, requires a clearer structuralization of it. Its following elements have to be clearly defined within the country's agro-industrial complex: specialized interbranch complexes (for example, cotton complexes), territorial complexes (for example, the complex of the Non-Black Earth Zone

of the RSFSR), specialized associations (for example, Moldplodoovoshch), and specialized enterprises (for example, the Sovkhoz-plant). Special managerial agencies endowed with the appropriate authority have to be created to manage these elements of the AIC.

The development of special-purpose programs makes it possible to concentrate resources and, consequently, to make overall use of the basic factors of production intensification (mechanization, chemicalization, land improvement, and biological factors). In this case the necessary effect is achieved. This was the case, for example, in developing the Golodnaya Steppe in Uzbekistan for the production of cotton and in the creation of a new rice sowing base in the Kuban'. These and other examples bear witness to the fact that we have already built up experience in carrying out large special-purpose programs in the field of agriculture. However, a wider look has to be taken at the problem of improving the planning and management of the agro-industrial complex. There are still a number of unsolved problems here. This applies above all to the necessity for improving the system of state procurements of agricultural products in order to ensure a rational zonal and economic specialization and concentration of production.

The practice of a leveling distribution of scarce material and technical resources without regard to the plant increase and output production was rightly subjected to criticism at the 25th Congress. It is scarcely justifiable to have a procedure in which the state procurement plans are assigned from above, while the draft plans for production specialization and concentration are made up independently of this by the oblasts, rayons, and farms themselves. This kind of situation makes it difficult to adopt objective planning decisions with regard to overall national economic interests. It should also be noted that in a number of oblasts, there is a widespread unjustified practice of replacing detailed economic calculations with the "planning" of production and procurements at approximately the same rates from the achieved base.

In 1965, the stimulation of the production of above-plan output was introduced through 50 percent markups over the procurement price. At a certain stage this played an important role. However, it cannot but be seen that this kind of procedure engenders an endeavor to understate plans on the part of certain economic executives.

The necessity has also arrived for expanding the horizon of planning and strengthening the development of economic norms, for planning from the finished output of the complex, and for solving a number of other methodological problems. In particular, the indicators for the amount of the production and procurements of agricultural products in physical terms and for the yield of agricultural crops sometimes do not take account of the national economic demands upon output quality.

The system of incentives has to be organically connected with the criteria and indicators of actual efficiency, which requires a further improvement of economic levers and stimuli.

Correct price setting is an important condition for ensuring the balanced development of the branches of the AIC and for stimulating their efficient work. A great deal has already been done in this field. Procurement prices have been increased for many agricultural products (in particular, by decision of the July (1978) Plenum of the CC CPSU), definite work has been performed on the territorial differentiation of procurement prices, and so forth. However, a parallel process is taking place of increasing the cost of the production of output and, moreover, frequently at outstripping rates. The following factors which have given rise to an increase in the cost of agricultural output can be distinguished.

First, the branches of sphere I of the AIC frequently unjustifiably increase prices for the means of production which are supplied to agriculture. For example, the prices for the new types of K-700 and K-701 tractors per unit of engine capacity are 30 to 40 percent higher than the prices for the same tractors of previous models. The prices for new trucks per ton of load capacity are also 20 to 40 times higher than for the trucks of the beginning of the 1960's. In 1971-1975 the cost of a single livestock place which had been built on the country's sovkhozs was 4.7 times higher than in 1961-1965.

The prices for mineral fertilizers have also been increasing to a greater extent than their nutritional content. In addition, there are essential differences in the cost of the nutritional substances contained in the mineral fertilizers which are shipped to agriculture. If we calculate the price of fertilizers per ton of nutritional substance, it will turn out that in nitrogen fertilizers it fluctuates from 54 to 174 rubles, in phosphorous fertilizers--from 88 to 160 rubles, and in potassium fertilizers--from 19 to 65 rubles. Such price differences can hardly be regarded as being justified by any important factors. A similar situation exists for many types of construction materials, combined feeds, and so forth.

It is completely obvious that this kind of price formation practice for the material and technical resources which are supplied to agriculture has a negative effect upon the economies of kolkhozes and sovkhozes. Prices for new means of production have to be established strictly with regard to the effect of their use. An increase in prices must not outstrip the increase in the productivity of the corresponding means of production.

Secondly, the expenditures connected with wages in agriculture do not always reimburse themselves. The wage systems on the kolkhozes and sovkhozes have to be organically coordinated with an increase in the amounts of output production and in efficiency. The lagging of labor productivity growth rates behind an increase in wages leads to an increase in the cost of output and limits the possibilities for intra-farm accumulations. The

increase in the capital-labor ratio of agricultural production, which was discussed above, is having a definite influence on an increase in the cost of output: This increase is explained not only by the increase in prices for equipment, but also in a number of cases by its poor use and by the lagging development of the infrastructure. It is important to emphasize that to a substantial extent these shortcomings can and must be overcome through the efforts of the collectives of agricultural enterprises themselves--the party is orienting them toward this. At the same time, additional measures from the state are essential. In particular, there has to be a further improvement of procurement prices. The procurement price levels for individual products and their correlations lead to uneven profit levels for production and to dissimilar results for it under the same conditions and do not always help to deepen production specialization.

The existing procurement prices for grain crops, sunflower seeds, eggs, and certain other products make it possible to obtain a sufficient profitability level. In these branches the incomes of the farms ensure expanded reproduction. The situation is worse with the prices for certain other cropping and animal husbandry products. Some branches continue to produce losses or negligible profits, which holds back the development of the specialization of the farms.

In the process of improving procurement prices it is essential to:

eliminate the substantial differences in the profitability of output and ensure accumulations sufficient for expanded reproduction at planned rates in every branch of agriculture;

strengthen the stimulation of the production of those products in which, as a result of the special characteristics of soil, climatic, and economic conditions, every zone specializes;

ensure a more exact calculation in procurement prices of the content of nutritive and other beneficial substances (sugar in sugar beet, protein and fat in milk, and so forth);

make wider practice of differentiated payments of the rent-type to the budget on the basis of the land register.

An improvement of the cost accounting relations between the elements of the AIC is one of the very important key issues. At the present time, there is an insufficient ordering of relations between agricultural enterprises and associations and the enterprises and associations of the State Committee for Agricultural Equipment and land improvement and water resources agencies. There needs to be an improvement of their relations with construction and processing enterprises, procurement organizations, and so forth.

Direct economic relationships are violated by the existence of a wide system of subsidies and privileges for agriculture, and also by a system of two price levels for the same means of production for agriculture and industry. All of this makes difficult a correct evaluation of the socially necessary expenditures for the production of output and of the economic efficiency of branches and enterprises.

What is necessary in order to transfer the interrelations between the basic branch and functional elements of the AIC to a genuinely cost accounting basis? First of all, the development of a mutually acceptable system of stimuli--incentives and liability measures--for the punctual and high quality fulfillment of plans and contract commitments which takes account of the economic interests of each element. Under present conditions, he who receives an understated plan and more resources frequently finds himself in a better position. It is necessary to make the system of evaluating the work of enterprises, associations, and larger territorial and economic elements directly dependent both upon resources supplies and upon the correlation between their normed and actual efficiency. This kind of mechanism should interest collectives in strenuous plans and ensure their economic responsibility for the use of resources.

The long-term contract based on cost accounting principles and including the conditions and stimuli for mutual output deliveries, for the provision of services, other commitments, and the indicators for evaluating the final results of the work of the AIC subdivisions has to become the basic form of economic relationships in the AIC system. In our opinion, in order to ensure the effective interest of the sales and supply system and the production services system in a more active influence on the efficiency and quality of the work of the AIC as a whole and of its structural elements it is necessary to transfer these systems and their territorial subdivisions to self-reimbursement which depends entirely upon final results. Then the procurement system and the enterprises and associations of the State Committee for Agricultural Equipment and of the agricultural production and agro-chemical services will not only be financially interested in a better performance of their functions, but will also bear direct responsibility for their decisions and for the fulfillment of their contract commitments.

More attention has to be devoted to improving the methods of stimulating an increase in labor productivity. Wider use has to be made of progressive forms of wages for final production results and of the rational use of productive capital and material resources. Many of these forms are well known and their effectiveness has been proven by practice. They include, for example, the job plus bonus systems, non-job sheet systems, and so forth which are oriented toward final production results and toward improving output quality and the effectiveness of productive capital and material resources.

There needs to be a further improvement of the relationships between agricultural and agro-industrial enterprises and associations and the state in the field not only of price formation, but also of the development of a system of rental payments, fees for capital and other resources, and fees for credit. An end should be put to the practice of the formation of the so-called free profits remnant and the distribution of profits between the state and agricultural enterprises should be improved.

Approximate calculations by economists show that a reorganization of the economic mechanism and of the entire system of economic relations in the AIC in the above-considered directions which ensure a consistent use of cost accounting methods, and a more active influence by economic levers and stimuli on the final results in efficiency of production will make it possible to achieve the long-term goals which have been set for the AIC with an economy of many billions of rubles in capital investments. It has to be said that these calculations are confirmed not only by the experience of the advanced elements of the AIC in our country and by economic experiments. The economic role of cost accounting relations based on economic interest, on a stimulation of managerial initiative and planning, and on the organization of production and an increase in its efficiency is also confirmed by the experience of a number of socialist countries. An instructive example is provided by Hungary where since 1964 enterprises and all of the intermediate production and managerial elements in agriculture and in the AIC system as a whole have been transferred to complete cost accounting; that is, to self-reimbursement and contract relations. State plans are realized through a system of contract relations and, at the same time, economic levers (prices, the forms of the withdrawal of profits, and so forth) have been put into good order. Administrative barriers were successfully overcome and managerial initiative was developed and, as a result of the economic reform, the efficiency of the country's agriculture has substantially increased. The experience of Hungary shows that an overall improvement of the system of the economic mechanism within the AIC can lead to substantial qualitative changes in the entire reproduction process and, above all, to an increase in output with a relatively small labor and resources expenditures.

There has to be a coordinated solution of the problems of the development of agriculture and the other branches and spheres of the AIC. We are speaking precisely about the development of the entire complex, about pursuing a single technical and economic policy in its system, and about the use of uniform forms and methods of planned management on the basis of the active use of economic levers: cost accounting, prices, profits, credit, and effective contract relations with an effective system of stimuli and sanctions.

Finally, a further acceleration of scientific and technological progress in all of the member branches of the AIC is a very important issue. What is involved here is not simply a quantitative increase in the deliveries of the means of production to agriculture, but the creation of progressive

and highly efficient technologies. Machine building has to provide for the creation of machinery and equipment complexes and systems which not only eliminate or reduce to a minimum manual labor in agriculture and in the processing branches, but which also ensure a rise in production efficiency and an immediate solution of the urgent problem of eliminating losses at all of the stages of the production, storage, and processing of agricultural output. Chemistry has to shift to the production of the kinds of mineral fertilizers and plant protection agents which are not injurious to human health or the environment. Water resources construction has to develop the kinds of land improvement methods which will allow a maximum economy of the expenditure of water and will prevent soil aridity, salination, and swamping.

Economic science has now theoretically developed and experimentally verified the principles of a special-purpose programmed method of planning and managing social production and its complexes, the economic levers of economic management, and the mathematical methods of optimizing economic development, including in the AIC. The task now is to work jointly with state planning and managerial agencies in a more effective use of this arsenal in the practice of planning and managing the economy so as to ensure the best use of the available resources and possibilities in all of the elements of the agro-industrial complex.

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CONFERENCE ON OPTIMUM USE OF RESOURCE POTENTIAL

Moscow PLANOVoye KHOZYAYSTVO in Russian No 5, May 79 pp 124-126

[Article summarizing conference by N. Vasilov and L. Troparevskaya]

[Text] In December 1978 an all-union scientific conference was held in Moscow on the topic "Levers in the Cost Accounting System for Achieving Efficient Use of Material, Labor, Financial and Natural Resources," organized by the scientific council of the USSR Academy of Sciences for "Scientific Foundations of Cost Accounting," TsEMI [Central Economics Institute of the USSR Academy of Sciences], and MIU [Moscow Management Institute imeni S. Ordzhonikidze. Scientists, managers in the economy, and first rankers in production took part in the conference.

In his welcoming speech to the participants in the conference A. M. Rumyantsev, member of the academy, stressed that specific measures will have to be devised to improve the economic mechanism, greater attention will have to be paid to the problems of enhancing the role of planning in achieving high final results of economic activity, and comprehensive national economic programs will have to be drafted and consistently implemented to achieve efficient use of the country's economic potential.

Research in the field of economic incentives and development of the cost accounting system needs to be concentrated on the problems of combining centralized planning with broad economic independence of major production complexes through the use of a system of economic norms with a long period of validity. The set of norms must be made the basis for preparing decisions on use of natural and labor resources, capital investments and environmental protection.

The address emphasized that practical implementation of measures to strengthen economic incentives and the effectiveness of the system of economic norms depends on efficient operation of the finance-credit mechanism.

P. G. Bunich, corresponding member of the USSR Academy of Sciences, noted in his paper, which was entitled "Resource Use and Economic Mechanism of Management," that one of the most important requirements the economic mechanism

must meet is that it must stimulate the interest of economic entities themselves in the concentration and specialization of production and in its technical improvement. The principle of the profitability of renewing the productive plant of associations, which engenders internal motivations for development, must be the basis of continuous technical progress. The method of incentives based on plan fulfillment, which is now in effect, detracts from the economic responsibility of collectives for optimum resource use, which is manifested in the creation of overstocked inventories at enterprises, the use of raw materials which are too expensive, and a drop in rates of use of equipment and labor productivity. This is bringing about undesirable changes in production costs and causing shortages of resources. These adverse phenomena can be overcome, in the opinion of P. G. Bunich, by assessing the results of economic performance with respect to the indicator of net profit.

P. P. Koshuta (USSR State Committee for Prices) devoted his paper to the role of the system of price setting in efficient resource use. He noted that the task of economic incentives to motivate efficient use of resources can be performed effectively only on the basis of a coordinated interaction and comprehensive linkup of the systems for planning, assessment of economic performance, material incentives, financing and price setting. He, moreover, emphasized the dual role of prices, which act as criteria in evaluating efficiency of resource use on the one hand and as incentives for raising efficiency on the other, linking the interests of producers with those of consumers. Price setting methodology and practice must create favorable conditions for encouragement of cost economies not only in the production process itself, but mainly in the process of designing the most technically refined and economically efficient machines and equipment, those which ensure optimum resource use. To that end, in the speaker's opinion, price setting methodology must be linked to the methodology for determining the national-economic efficiency of a new product and also with the system of standardization and certification of product quality. Moreover, the indicator of the level of efficiency must become the principal success indicator of cost accounting performance at all levels of management.

It would be wise if production of a new product were subject to standard allowances for the consumption of material and energy resources per unit capacity or per unit productivity of machines; the level of ceiling prices would ensure the consumer a cheaper new product per unit performance. Since consumers do not bear responsibility for attainment of design indicators outlined in engineering development, calculation of the improved performance often proves to be high.

The legal problems of the economic mechanism were treated in the paper of V. V. Laptev (Institute of Government and Law of the USSR Academy of Sciences). Work is now being done to prepare the code of USSR laws in which an appropriate section will be devoted to economic legislation, which takes into account the principles of the new Soviet Constitution. This means that economic legislation has to be accommodated in a single system. To be

specific, the legal status of associations of the mixed type has to be regulated, and regulations on sectors and industries, homogeneous economic complexes have to be standardized, and the peculiarities of their activity have to be taken into account. Legal regulation has a particularly large role in the planning field. Questions are being asked about the legal aspects of establishing planning targets assigned to the enterprise, of the role of business contracts as a means of shaping the production plan, of the procedure and deadlines for establishment of the plan and of deadlines for possible amendments in it. In the opinion of V. V. Laptev, a system of measures is needed to avert violations of legislation in the field of planning and economic management.

The paper points out that experience in concluding business contracts at the middle level of management has been reflected in legislation. V. V. Laptev expressed the opinion that it would be advisable for contracts to be concluded at the superior level of industrywide and sectorwide management as well, since this would be conducive to coordination of their activity. An urgent solution is needed to the problem of establishing the economic responsibility of all bodies of sectorwide and industrywide management, including superior bodies, or the decisions taken.

D. S. L'vov (TsEMI) emphasized in his paper the need to define a system of indicators for measuring the efficiency of resource utilization. The large number of methods of evaluating the efficiency of capital investments and new technology makes it possible to demonstrate in practice the advantage afforded by any project or design. Only if a unified system of assessment of the efficiency of resource utilization is created can one speak of setting up a rational incentive system. Note was also taken of the advisability of working out a unified method of determining the efficiency of social production that would embrace all its stages.

The role of socialist competition in the effort toward efficient use of resources was reflected in the paper of V. K. Fedinin (of the newspaper SO-TSIALISTICHESKAYA INDUSTRIYA). The speaker emphasized that the organization of competition is an integral part of the mechanism for planned management of the economy. The better cost accounting is organized, the greater the opportunities for development of creative activity and initiative of the workers. Cost accounting creates the objective prerequisites for precise assessment and comparison of the results of production performance, and competition promotes improvement of the cost accounting organization of production itself and a strengthening of economic responsibility.

In the opinion of V. K. Fedinin, improvement of the system of incentives must pursue the direction of a more intimate relation between incentives based on the results of socialist competition and the main bonus systems. Material incentive funds should be formed not on the basis of indicators of sales plans, but on the basis of the efficiency indicators that determine rankings in competition. These arguments are confirmed by the practice of organizing remuneration and distribution of incentive funds at advanced enterprises of the USSR and other socialist countries.

The problems of motivating rational timber management were treated in the paper of L. Ye. Mikhaylov (USSR State Committee for Forestry). He noted that the length of the production process of raising timber makes it especially urgent to have long-range planning in the industry as an exceedingly important element of overall state measures toward conservation and optimum utilization of natural resources. The present system of value indicators in the plan does not meet those requirements. Prices in the timber industry do not reflect socially necessary expenditures, which detracts from the effectiveness of economic decisions and levers used in management.

In the paper of V. M. Ivanchenko (USSR Gosplan), which was entitled "Enhancement of the Stimulative Role of the Indicators of the Plan," particular emphasis was put on improvement of planning as an integral part of the economic mechanism. An important problem in planning is determining that pattern of production which will be efficient in the future. Solving that problem requires the systems approach to compiling the long-range plan. Moreover, economic levers and the price setting system should be joined in such a way as to accommodate the requirements of the state's social welfare policy. Under those conditions, in the speaker's opinion, it is unrealistic to place hopes on the normative role of prices. Reliance in decisionmaking must be put on the system of economic indicators once each one's place in economic calculations has been determined.

K. N. Plotnikov, corresponding member of the USSR Academy of Sciences, emphasized in a paper entitled "Problems of Improving the Financial-Credit Mechanism" that the functioning of a socialist economy needs extensive utilization of value relations and indicators. There is a real need for improvement of this domain of the economic mechanism. Great importance was paid in the paper to the problems of improving the relations between cost accounting entities on the one hand and the state budget and banks on the other, the present system of collecting the turnover tax and payments from profit is discussed, and a number of measures are proposed for making it more effective. K. N. Plotnikov deems it essential that a strict dependence be established between collection of payments to the budget on the fact of final realization of that portion of net income and that local authorities be given greater freedom in establishing the rates of the turnover tax and rates of deductions of a certain part of it for local authorities and for incentive funds of enterprises.

B. V. Rakitskiy (NIEI [Scientific Research Institute of Economics of USSR Gosplan]) noted in his paper the unity between the social and economic criteria of the efficiency of social production and of scientific-technical progress.

The other papers, including those delivered in the sections, discussed the questions of improving cost accounting incentives to motivate economies in use of material resources, optimum utilization of fixed capital, raising the output-capital ratio, improving product quality, improving the organization of cost accounting in production associations, conservation of natural

resources, profit-and-loss incentives for development of agriculture and forestry, and so on.

Various aspects of the topic of the conference dealt with by its participants were reflected in the recommendations.

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METHODOLOGY OF EVALUATING THE EFFECTIVENESS OF NEW TECHNOLOGY

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[Article by V. N. Livshits, D. S. L'vov and Yu. V. Ovsiyenko: "Methodological Problems in Evaluating the Economic Effectiveness of New Technology"]

[Text] The article examines general and comparative effectiveness and spheres of application of these concepts in economic calculations. Substantiation is offered for methods used in determining the one-year and time-integral economic effect resulting from the production and use of new technologies. Analysis of various concepts of normative effectiveness of capital investment provides the basis for the stricter identification of its economic nature and for eliciting the influence exerted on its numerical value by various economic parameters.

The enhancement of the scientific substantiation of decision-making methods at all levels of planned management, the precise delineation of functions between them, and the improvement of the quality of information used in the process are important conditions to the further improvement of the management of the socialist economy. The 25th CPSU Congress indicated the need to "develop democratic principles and the initiative of the masses, to free the upper echelons of management of petty details, to secure efficiency and flexibility in the decision-making process."*

In order to resolve this problem it is particularly essential that the lower levels of management make a preliminary economic assessment of potential economic measures and filter out measures that obviously should not be included in the national economic plan even in the hypothetical case that the corresponding organs of management are fully informed on all possible measures and variants of economic development and can operationally rework this information in the planned decision-making process. In other words, the point is to use preplanning economic calculations at the local

*"Materialy XXV s'yezda KPSS" [Materials of the 25th CPSU Congress]. Moscow, Politizdat, 1976, p 21.

level to bring about a significant reduction in the labor-intensiveness of the compilation of the plan by managerial organs at higher levels without impairment of quality. An important place in the solution of the given problem belongs to widely used methods of determining the comparative economic effectiveness of alternative economic measures.

The task of comparing and selecting different variants of planning decisions constantly arises in the process of the socialist economy's development. Thus, in the project-planning stage, several versions of one and the same project are usually developed and the appropriate project-planning organization chooses the best of the lot.

Methods used to evaluate the economic effectiveness of new technology become very important in this regard. Confirmed in 1977, the Methods for Determining the Economic Effectiveness of New Technology* introduce methodological uniformity into the system of technical and project-planning decisions. The fundamental principle is the national economic approach. It is reflected in the fact that the selection of the optimum technical solution must be based not on the criteria of the cost-accounting effectiveness of production (profitability, output-capital ratio, etc.), but must be in accordance with the criterion of minimum annual discounted costs and maximum net national economic profit. At the same time, calculations of annual discounted costs use a normative coefficient of economic effectiveness of capital investments that is uniform for all branches and in addition to financial and material resources consideration is also given to the time required for the realization of various projects.

At the same time, the existing methods cannot be regarded as a document that provides the final answer to all problems regarding the measurement of the economic effectiveness of new technology. Its content only reflects a certain phase in scientific research that is presently being expanded in myriad directions. Some of the basic principles require additional clarification especially for specialists that calculate the economic effectiveness of new technology. They include first and foremost: the correlation of criteria of general and comparative effectiveness; the substantiation of methods and indicators used in the evaluation of the national economic effect deriving from the production and use of new technology and spheres of application of various formulas; and the essence and numerical value of such an important economic category underlying the given calculations as normative effectiveness.

The present article is devoted to the investigation of these questions.

*"Metodika (osnovnyye polozheniya) opredeleniya ekonomicheskoy effektivnosti ispol'zovaniya v narodnom khozyaystve novoy tekhniki, izobreteniy i ratsionalizatorskikh predlozheniy" [Methods (Basic Principles) Used in Determining the Economic Effectiveness of New Technology, Inventions and Innovations in the National Economy]. Moscow, Ekonomika, 1978.

1. The General and Comparative Effectiveness of Capital Investments

The "Standard Methods for Determining the Economic Effectiveness of Capital Investments in 1969" recommend two principles for evaluating economic effectiveness: general (absolute) and comparative.

The two principles are formulated as follows: "The effectiveness of capital investments is determined by comparing the effect and the expenditures. Planning and project-planning define the general (absolute) economic effectiveness as the ratio of the effect to total capital investment and in the choice of variants of solution of economic or technical problems while comparative economic effectiveness shows the degree to which one variant is more effective than another."*

General effectiveness is defined as the ratio of national income to productive capital or the ratio of the increment in national income or profit to the capital investment responsible therefor. In the given instance, the effect refers to total national income or its increment (or to total profit or its increment).

Comparative effectiveness is determined on the basis of the difference in so-called annual discounted costs. In the given instance, the effect refers not only to the total increment in profit but only to the above-norm increment that forms after the product obtained from multiplying the normative coefficient of effectiveness by additional capital investments, i. e., its normative part, is subtracted from profits.

The output-capital ratio based on national income is also frequently counted as an indicator of general effectiveness. At the branch level and in individual enterprises, the output-capital ratio can be determined on the basis of net (conditionally net) output or the sales indicator. However changes in the effectiveness of production cannot be assessed on the basis of the output-capital ratio. In some cases it may decline even though it may attest to a decline in the effectiveness of production. "The latter," Academician T. S. Khachaturov notes, "may even rise, e. g., as a result of the lowering of routine costs or the prime cost of production. Essentially the calculation of the effectiveness of capital investments reduces in large measure to the comparison of one-time costs and prime costs. Therefore, under certain conditions it is expedient to resort to additional costs if the saving in routine costs recoups them within a normative period of time."**

*"Tipovaia metodika opredeleniya ekonomicheskoy effektivnosti kapital'nykh vlozheniy" [Standard Methods for Determining the Economic Effectiveness of Capital Investments]. Moscow, Ekonomika, 1969, p 4.

**T. S. Khachaturov, "On Criteria and Indicators of Effectiveness of Social Production," "Kommunist," No 5, 1975, p 88.

As we see, the output-capital ratio is an unsuitable indicator for evaluating the effectiveness of production. And this is, of course, as it should be. We can only add that the orientation toward the growth of the output-capital ratio for every economic entity is moreover not always coordinated with the growth of the total, overall output-capital ratio for the entire aggregate of entities. Let us cite an example. Let us assume that there are two enterprises producing the same product, e. g., television sets or refrigerators. The net output of these enterprises is eight million and two million rubles while the capital investment in their productive capital is 20 million and 10 million rubles, respectively. In such a case, the output-capital ratio will be 40 kopecks per ruble of capital at the first enterprise and 20 kopecks per ruble of capital at the second. The total output-capital ratio in this instance will be 33 kopecks per ruble of capital. Let us now see what happens to the total, overall output-capital ratio when both enterprises are motivated to increase their output-capital ratio. Let us assume that it is possible to redistribute the investments in the opposite direction, i. e., to give the first enterprise 10 million and the second enterprise 20 million rubles in capital investments. At the same time, let us assume that given the same combined output volume for both enterprises the volume of net output is 4.5 million rubles at the first enterprise and 4.4 million rubles at the second. Then the output-capital ratio will raise from 40 to 45 kopecks at the first enterprise and from 20 to 22 kopecks at the second. But the overall output-capital ratio for the two enterprises will decline from 33 to 29.7 kopecks in the process.

The given "paradox" is not the result of calculating the output-capital ratio on the basis of net output. We could cite similar examples in which the output-capital ratio is calculated on the basis of gross, marketable or realized output. The point of the matter is the the output-capital ratio does not satisfy the condition that local objectives of the development of production be subordinate to general, integral interests of the development of the economic system as a whole.

Profitability -- an indicator widely used in economic practice -- is another indicator of general effectiveness. One might ask whether profitability can be used to reflect the change in the effectiveness of production more completely. Before answering this question, let us address ourselves to the following example. We shall examine two variants of the development of production (Table 1).

Table 1. Variants of Development of Production

Indicator	First	Second
Annual output (U) (millions of rubles).....	5	5
Prime cost of annual output (C) (millions of rubles)....	4.2	3.6
Capital investments in productive capital (K) (millions of rubles).....	2	4
Profitability $\left(\frac{U-C}{K} \cdot 100\right)$, %	40	35
Annual discounted costs $[3=C+E_s K (E_s=0.15)]$ (millions of rubles)	4.5	4.2

As we see, the second variant of development of production requires two times more investment to produce the same five million rubles' worth of output and, moreover, the profitability declines from 40 to 35 kopecks per ruble of capital. It would seem that the second variant should be rejected and the first adopted. But we are restrained by the criterion of comparative effectiveness: discounted costs in the second variant are 300,000 rubles lower. Why is this so? As it turns out, when we select the first variant on the basis of the criterion of general effectiveness we at the same time increase current costs by the equal output volume in the sum of 600,000 rubles (4.2-3.6). Let us assume that in the given instance, we are concerned with the overexpenditure of fuel in transport. In order to compensate the given overexpenditure, we must put additional capacities into operation not in transport but in oil refining branches. In what way can the volume of investment in these allied branches compensate the annual overexpenditure of fuel in the sum of 600,000 rubles? The answer to this question can be found in the general theory of comparative effectiveness of capital investments, which advanced as a yardstick of the effectiveness of utilization of capital investments resources their optimum evaluation, which is called the normative coefficient of effectiveness of capital investments (E_H). Without discussing for the time being the methods used to calculate this coefficient, we note that it is close to 0.15 at the present time. This means that from the standpoint of planned economic management as a whole, we must strive to see to it that the return on every ruble in every economic link would be at least 15 kopecks. But if this is the case, it is an easy matter to calculate for our example the necessary volume of investment in connection with the annual loss of 600,000 rubles. It will amount to $600/0.15=4$ million rubles. It turns out that the realization of the first variant requires not two million rubles in investments but six million rubles, of which four million are beyond the purview of the profitability indicator. And only additional calculations make it possible to elicit the more capital-intensive variant which initially seemed to be less capital-intensive. But it would not be necessary to resort to such calculations if the comparative effectiveness criterion were used in the economic substantiation of the variants. Thus, in our example the discounted costs in the second variant proved to be 300,000 rubles lower than in the first variant thereby attesting to the economic superiority of the second variant.

As we see, neither profitability nor the output-capital ratio can serve as a reliable indicator of the effectiveness of production in the given instance. But does this mean that the general effectiveness indicator should be omitted entirely from the evaluation of the effectiveness of production? By no means. The general effectiveness indicator has its own, very important sphere of application.

Indeed, the instrument of comparative effectiveness permits us to examine several comparable variants and to choose the optimum from a national economic point of view. It is specifically the calculations of comparative effectiveness (and they alone) that guarantee that if -- out of the possible number of variants of performance of the necessary work -- the variant with the

lowest cost is chosen, the resources used will produce an effect no smaller than the effect that could be obtained in the national economy if these resources were transferred there.

The given condition stems directly from the formula of discounted costs because $C + E_H$ represents, as V. V. Novozhilov so aptly phrased it, "full national economic prime cost."

In addition to current costs (C), national economic prime cost also takes into account additional losses ("feedback costs" according to V. V. Novozhilov) arising in connection with the diversion of capital investments from national economic circulation (E_H).

The instrument of general or absolute effectiveness is used for other purposes. First of all, it is absolutely essential in evaluating the practicability of the optimum variant in economic practice. The question naturally arises: how optimal is the formulation of the aggregate of variants from which the optimum is chosen? Perhaps the most effective variants are left out of consideration. And indicators of absolute effectiveness, when they decline, serve the economist as an additional, inestimable signal of the need to verify the basic premises underlying the calculation of comparative effectiveness: the completeness of the set of variants under examination, the comparability of modes used to take expenditures and effects into account, the reliability of prices used, etc. It is possible that in the example examined by us above, in addition to the two variants there is yet another, third, variant with basically new technology such that the prime cost of annual output will be 3.0 million rubles and the requisite capital investments in productive capital will be 4.8 million rubles. The third variant will be more effective than the second (annual discounted costs: $3.0 + 0.15 \cdot 4.8 = 3.72$ million rubles) and its profitability will be highest $(5 - 3) / 4.8 = 42\%$.

However, the advent of one more variant is the consequence of supplementary analysis occasioned by the lowering of the general effectiveness indicator.

It should be noted here that if supplementary analysis did not produce such a third variant, preference should be given to the second variant (even though its profitability is lower).

From the foregoing, it follows that the area of utilization of general (absolute) effectiveness must in practice be confined to the tasks of technico-economic analysis of basic variants or of forming basic positions for the calculation of comparative effectiveness. But at the same time, indicators of general effectiveness cannot be used for the direct comparison and selection of the most advantageous variant of technical solutions. In the latter instance, it is expedient to use methods to determine the comparative effectiveness of capital investments based on the minimization of discounted costs.

We note that in addition to the criterion of annual discounted costs ($C+E H_i \rightarrow \min$), it is also possible to use other criteria, e. g., the criterion of the so-called investment recoupment period. The essence of this method is as follows: if there are several variants of performance of one and the same useful work (identical in volume, time, and quality), the optimum variant can be found by going through a chain of comparison pairs. For example, let us compare variant N_i and the variant N_{i+1} , which differs by virtue of the fact that the i -th variant has lower capital investments but higher annual operating costs (i. e., $H_i < H_{i+1}$, while $C_i > C_{i+1}$).*

Thus the recoupment period method compares "actual recoupment time" $T_0 = (K_{i+1} - K_i) / (C_i - C_{i+1})$ and normative "recoupment time" $T_n = 1/E_n$. If it turns out that $T_0 < T_n$, then the better variant is the one with the higher capital investments, i. e., $i+1$; if $T_0 > T_n$, then the variant with the lower capital investments is better, i. e., the i -th variant. In such a case $T_0 = T_n$ are equally economical variants.

The procedure for making calculations on the basis of the "recoupment time" is common knowledge. Nonetheless, there are frequent errors. The most frequent (and simplest) of them is the following. It is considered that an increase in effectiveness is equivalent to reducing the recoupment time and that the criterion for selecting the most advantageous variant may be the minimum actual recoupment period, i. e., a criterion of the type

$$\min_i \frac{K_i - K_0}{C_0 - C_i},$$

where K_0 and C_0 are capital investments and operating expenditures of the variant taken as the base (the least capital-intensive variant is usually taken as such).

Let us use a concrete example to illustrate the illegitimacy of using the given criterion. Let there be four variants of solution of one and the same production problem (Table 2).

As we see, the smallest "recoupment period" vis-a-vis the base is the first variant whereas the third, whose recoupment is three times greater, is the optimum.

It is not by chance that the "recoupment period" is enclosed in quotation marks. It usually refers to the time during which the real accumulated

*In the opposite case (i. e., if one variant has smaller capital investments and smaller operating costs than another), there is no problem. Such variants should not be compared since without making the comparison it is obvious which of them is best.

economy in routine operating costs equals initial additional capital expenditures. Let us examine the cited example from this point of view. In the optimum, third variant the "recoupment period" is equal to three years. And indeed, each year of saving of operating costs is four million rubles (8-4), and the initial capital investments are 12 million rubles (14-2). Everything would appear to be in order: in the space of three years, the saving would appear to offset the initial additional investments. But this is arithmetic and not economic calculation. After all, every economist knows that a saving of four million rubles in the first year is worth considerably more than four million rubles of saving, e. g., in the third year and less than four million rubles in capital investments made prior to operation. Indeed, if we were simply to deposit the money in a savings bank, there would be not four million rubles but more. From a national economic point of view, this growth rate of value (the influence of the time factor) must be taken as close to the effectiveness norm in the national economy, i. e., 15 percent a year. Therefore, there will be no real recoupment of 12 million rubles in three years at an annual nominal saving of four million rubles a year. In this regard, the words "recoupment period" do not have the indicated substance and this is one more reason that the "minimum recoupment period" criterion can lead to erroneous results.

Table 2. Variant Solutions to the Production Problem

Indicator	Base	First	Second	Third	Fourth
Prime cost of annual output (millions of rubles)	8	6	5	4	3
Capital investments in productive capital (millions of rubles)	2	4	8	14	22
Recoupment period relative to base variant	-	1	2	3	4
Annual discounted costs (millions of rubles)	8.3	6.6	6.2	6.1	6.3

For this reason, in the new Methods the recoupment time indicator is viewed not as a basic indicator but as a supplementary analytical indicator. The selection of the most economical variant of new technology and the determination of the economic effect from its use in the national economy are made under the new methods by comparing discounted costs.

2. The Annual Economic Effect of New Technology and Methods Used to Calculate the Effect

The economic effect indicator is the most important indicator of the comparative effectiveness of new technology. It is "designed" on the basis of the normative coefficient of the effectiveness of investments and, unlike

indicators of effectiveness used in cost accounting, reflects the saving of investment that can be realized on a national economic scale given the realization of the chosen variant of new technology.

The economic effect indicator is basic in determining the size of bonuses for the development and use of new technology in the national economy. From this we understand how important it is to ensure the use of uniform methods in the planning and economic stimulation of new technology. However, such uniformity is by no means always found in existing documents relating to method. We can cite examples in which the calculation of the economic effect according to various methods produces results from the realization of one and the same measure that differ 2-3 fold or more.

These errors possibly would not have arisen if the existing methods used more precise terminology relating first and foremost to the concept "annual economic effect" and to the formulas used to calculate this effect.

The fact of the matter is that the concept "annual economic effect" is ambiguous. Let us explain this on the basis of a simple example while ignoring the time factor. Let us assume that a new product is produced in the amount of 1200 units a year, has a service life of 10 years, while the annual effect from applying a unit of the new product equals 1000 rubles in the course of a year. Then the effect from the application of all machines for a year will be $1200 \times 1000 = 1.2$ million rubles. The overall effect for the entire service life of these machines will be $1200 \times 1000 \times 10 = 12$ million rubles.

Thus, the following may be factors in determining the annual economic effect:

- 1) the effect attainable in each individual year from the annual diffusion of new technology, raw materials, etc. We shall denote this effect as Ξ^1 .
- 2) the economic effect that is obtained from the annual production of new long-term products not for one year but for the entire service life. Thus, the reference is to general (integral) economic effect, but from the annual volume of production of the new products. We denote this effect as Ξ^T .
- 3) the economic effect that is obtained in any given year for the entire service life of the new product from the annual volume of production. We denote this effect as Ξ^t .

The annual economic effect (Ξ^1) is determined as the difference of annual discounted expenditures on production with the aid of the base equipment (replaced) and new equipment in the volume ensured by the new equipment.*

*See "Metodika (osnovnyye polozheniya) opredeleniya ekonomicheskoy effektivnosti ispol'zovaniya v narodnom khozyaystve novoy tekhniki, izobreteniy i racionalizatorskikh predlozheniy" [Methods (Basic Principles) Used in Determining the Economic Effectiveness of New Technology, Inventions and Innovations in the National Economy], p. 8 (formula 3 in the Methods].

\exists^t is determined for the so-called calculated [raschetnyy] year of production. The new methods task as the calculated year the first year following the end of the planned (normative period of production of new equipment.

The formula for calculating \exists^1 is widely used in many methods in determining the annual economic effect from applying new technological processes, the mechanization and automation of production, and modes of organization of production and labor. The same formula is also used in calculating the annual economic effect from the production and use of new or improved means of labor (supplies, raw materials, fuel) and means of labor with a service life less than one year.

But what happens when we are faced with the question of using new long-term equipment with improved qualitative properties? We must evidently be concerned with another indicator of economic effect: \exists^T .

Earlier methods on evaluating the economic effectiveness of new technology* proposed determining the annual economic effect in the form of an algebraic sum of the annual economic effect of the producer (\exists_{Π}^1) and the user (\exists_{H}^1) of the new product, i. e.

$$\exists^T = \exists_{\Pi}^1 + \exists_{\text{H}}^1.$$

Let us examine the following example.

The manufacture of a more productive machine increases expenditures by 200 rubles. But in the use sphere, the new machine reduces expenditures by 100 rubles a year. Such an annual economic effect, determined in accordance with the recommendation indicated above, will be:

In other words, the new machine with the longer service life is economically ineffective. But in actual fact, such reasoning is simply incorrect since it is impossible to add the one-time (capitalized) economy (overexpenditure) directly to the user's annual saving.

$$\exists^T = -200 + 100 = -100 \text{ rubles.}$$

In order to exclude such an error, the one-time (capitalized) economy (overexpenditure) must be added to the saving to the user for the entire service life of the machine, i. e., $\overline{\exists^T} = \exists_{\Pi}^1 + \exists_{\text{H}}^1 T_1$,

where T_1 is the service life of the new machine.

Let us assume for the conditions of our example that $T_2 = 5$ years.

*"Metodika opredeleniya godovogo ekonomicheskogo effekta ot vnedreniya novoy tekhniki" [Methods Used to Determine the Annual Economic Effect from the Diffusion of New Technology]. Moscow, Ekonomika, 1961.

Then

$$\mathfrak{Z}^T = -200 + 100 \cdot 5 = 300 \text{ rubles a year.}$$

As we see, the results of the calculation are entirely different, which is also an indication of the high effectiveness of using a new, more productive machine. To be sure, we did not take into account the time factor, i. e., the nonidentity of effects obtained at different points in time. In order to correct this inaccuracy, we must reduce the effects of various years to a single, initial (calculated) year. In order to do so, we use the compound interest formula recommended in the Standard Methods for 1969:

$$\alpha_t = (1 + E_{\text{en}})^{-t},$$

where E_{en} is the reduction coefficient of expenditures made at various points in time.

In the calculation of renovation allowances with due regard to the time factor, the reduction coefficient must equal the normative coefficient of effectiveness of capital investments E_{e} . Therefore, we shall subsequently consider that:

$$E_{\text{en}} = E_{\text{e}} \text{ и } \alpha_t = (1 + E_{\text{e}})^{-t}.$$

Then the summary value of the economic effect reduced to the calculated year will be:

$$\mathfrak{Z}^T = \sum_{t=0}^{T_1} \frac{\mathfrak{Z}'_n + \mathfrak{Z}'_u}{(1 + E_{\text{e}})^t},$$

here \mathfrak{Z}'_n and \mathfrak{Z}'_u are the one-time saving (overexpenditure) of the producer and the year's saving (overexpenditure) of the user, respectively in year t .

But in our example, the overexpenditure of one-time costs \mathfrak{Z}_n occurs only in the calculated year, i. e., when $t=0$ and \mathfrak{Z}_n is independent of t and takes place in each year from the first to the last.¹ This permits us to write the previously cited expression in the following form:

$$\mathfrak{Z}^T = \mathfrak{Z}_n + \mathfrak{Z}_u \sum_{t=1}^{T_1} \frac{1}{(1 + E_{\text{e}})^t} = \mathfrak{Z}_n + \frac{\mathfrak{Z}_u}{P_2 + E_{\text{e}}},$$

where P_2 is the renovation norm for a new machine determined with regard to the time factor.

As A. L. Lur'ye showed back in 1948*

$$P_2 = \frac{E_{\text{e}}}{(1 + E_{\text{e}})^{T_1} - 1}.$$

*A. L. Lur'ye, "Metody sopostavleniya ekspluatatsionnykh raskhodov i kapital'nykh vlozheniy pri ekonomicheskoy otsenke tekhnicheskikh mero-priyatiy" [Methods for Comparing Operating Expenses and Capital Investment in the Economic Evaluation of Technical Measures]. Moscow, Transzheldorizdat, 1948.

For our example

$$P_1 = \frac{0.15}{(1 + 0.15)^1 - 1} = 0.148.$$

Hence

$$\mathfrak{Z}^T = -200 + \frac{100}{0.148 + 0.15} = -200 + 335.6 = 135.6 \text{ rubles per unit.}$$

As we see, the calculation of the effect with regard to the time factor yields a more precise evaluation which is 164.4 rubles (300-135.6) or 55 percent less than the initial evaluation.

The more rigorous conclusion of formula \mathfrak{Z}^T consists in the following. Let the unit cost of production of baseline technology be 3_1 , and the cost of new technology be 3_2 , and let their productivity and service life be B_1 and T_1 and B_2 and T_2 , respectively. If the net operating costs (not counting full-replacement depreciation) and the accompanying capital investments on the part of the user (calculated in terms of the volume of work performed by a unit of new technology) are equal in baseline technology U_1 and K_1' and in new technology U_2 and K_2' , national economic discounted costs will be:

-- for baseline technology used in the course of the year:

$$\frac{B_2}{B_1} 3_1 (P_1 + E_u) + U_1 + E_u K_1'$$

-- for new technology used in the course of the year:

$$3_2$$

The annual economic effect (per unit of new technology) will equal the difference between these expressions of \mathfrak{Z}^T , and the full national economic effect from the application of the annual output of new technology in A_2 units for its entire service life (i. e., for T_2) will be:

$$\begin{aligned} \mathfrak{Z}_A^T &= \sum_{t=1}^{T_2} \frac{\mathfrak{Z}^T A_2}{(1 + E_u)^t} = \mathfrak{Z}^T A_2 \sum_{t=1}^{T_2} \frac{1}{(1 + E_u)^t} = \\ &= \left[3_1 \frac{B_2}{B_1} \cdot \frac{P_1 + E_u}{P_2 + E_u} + \frac{U_1 - U_2 - E_u (K_1' - K_2')}{P_1 + E_u} - 3_2 \right] A_2. \end{aligned}$$

This is specifically how the conclusion of formula (4) in the 1977 Methods for New Technology was substantiated.**

*Expenditures on the amortization of accompanying capital investments K_1' and K_2' are included among operating costs U_1 and U_2 .

**"Metodika (osnovnyye polozheniya) opredeleniya ekonomicheskoy effektivnosti ispol'zovaniya v narodnom khozyaystve novoy tekhniki, izobreteniy i racionalizatorskikh predlozheniy" [Methods (Basic Principles) Used in Determining the Economic Effectiveness of New Technology, Inventions and Innovations in the National Economy], p 8 (formula (4) of the Methods).

The formula for determining the average annual economic effect of new technology Θ'_{cp} can also be directly obtained from formula Θ_A^I . This is readily apparent since

$$\Theta_A^I = \sum_{t=1}^{T_2} \frac{\Theta'}{(1+E_n)^t} = \frac{\Theta'_{cp}}{P_2 + E_n},$$

i. e.

$$\Theta'_{cp} = \Theta_A^I (P_2 + E_n).$$

Today, we frequently hear that calculations based on formula Θ_A^I produce an unduly high (by 4-5 times) annual economic effect. This is because calculations based on formula Θ_A^I , as already noted, determines the effect not for one year of use but for the entire service life (if only the annual volume of production of new machinery).

Naturally, the given effect will be T_2 times higher than the effect for one year if we neglect the time factor as in the example cited above and will be $1/(E_n + P_2)$ times higher if the time factor is taken into account where $E_n = 0.15$; $T_2 = 10$ years);

$$\frac{1}{E_n + P_2} \cong \left[0.15 + \frac{0.15}{(1 + 0.15)^{10} - 1} \right]^{(-1)} = 5.$$

Θ' is directly comparable not with Θ_A^I but rather with Θ'_{cp} , which as shown above is equal to:

$$\Theta'_{cp} = \left[3_1 \frac{B_2}{B_1} (P_1 + E_n) + (H_1 - H_2) - E_n (K'_1 - K'_2) - 3_2 (P_2 + E_n) \right] A_2.$$

Of course the calculation of the annual effect according to formula Θ_A^I is slightly simplified in certain respects. First of all it is assumed that characteristics of machines (their productivity, operating costs) do not change during their service life, that all machines are put into operation immediately in the year following their production, etc. There are indeed certain lags between the manufacture and use of machines. Let us assume that in the first year only half of the machines produced in year zero are put into operation while the others are put into operation in the second half of the year. This requires a certain adjustment in the calculation of the integral effect since in the first year the saving of current costs is only one-half (but for this, there will be an additional saving in year $T_2 + 1$).*

Thus, the integral effect Θ_A^I must be less by approximately

$$\Delta_3 = \left[\frac{H_1 - H_2}{1 + E_n} - \frac{H_1 - H_2}{(1 + E_n)^{T_2 + 1}} \right] \gamma A_2,$$

where γ is the share of machines put into operation not in the first but in the second year (in our example $\gamma = 0.5$)**

*For the sake of simplicity, it is assumed that $K'_1 = K'_2$.

**It is also easy to make a correction for a more complex case in which some of the machines are put into operation in the third or fourth year rather than the second, etc.

Calculations show that for real values of T_2 , lag, etc., the correction is slight and can be totally neglected. Thus, when $T_2=10$ and half of the machines are put into operation in the second rather than the first year,

$$\frac{\Delta_3}{(H_1 - H_2) A_1} = \left[\frac{1}{1 + 0,15} - \frac{1}{(1 + 0,15)^2} \right] \cdot 0,5 = 0,32$$

In other words, the correction applies to only roughly one-third of the saving resulting from the lowering of operating costs in one (the first) year. The correction for Δ_A^I will not exceed 3-5 percent. Such an error can for all practical purposes be ignored.

These calculations show in particular why we cannot agree with the comments of certain authors who propose that the effect be calculated on the basis of formula (4)* of the 1977 methods not for the annual volume of production of new technology, i. e., for A_2 but for half of it, i. e., $A_2:2$. The substantiation is that not all newly manufactured equipment is put into operation and hence the calculations must be made for the average quantity of equipment actually put into operation, which is taken as equal to $A_2:2$.

Let us cite an example.

Let us assume that 300 new excavators are manufactured each year. The effect resulting from the use of one excavator is 1200 rubles a year. Its service life is six years. Let us examine in the given instance the summary economic effect for the entire service life of the new excavators.

If the time factor is neglected in the calculation of $A_2:2$, the summary effect will be

$$1200 \cdot \frac{300}{2} \cdot 6 = 1,080,000 \text{ rubles.}$$

But is this correct? Of course not, and this is the reason. Let us assume that in any year of production of new excavators only one-half of the excavators will be put into operation. Thus in the first year of service, only 150 excavators will be used ($300/2$). But in the second and subsequent years of service, all 300 excavators will be in operation. Understandably, both the first and second lot of excavators will be in operation for six years but the time elapsing from the time of manufacture of the first lot will be six years and seven years in the case of the second lot. Such is the difference if the calculations are made with scrupulous precision. It would

*Metodika (osnovnyye polozheniya) opredeleniya ekonomicheskoy effektivnosti ispol'zovaniya v narodnom khozyaystve novoy tekhniki, izobreteniy i ratsionalizatorskikh predlozheniy" [Methods (Basic Principles) Used in Determining the Economic Effectiveness of New Technology, Inventions and Innovations in the National Economy], p 8.

be necessary to make a correction which, as we have ascertained, does not exceed 3-5 percent of the summary economic effect determined for the entire service life of new machinery, i. e., from $\Theta_{\Sigma}^I = 1200 \cdot 300 \cdot 6 = 2,160,000$ rubles. Then the effect with regard to the correction will be 2160 (1-0.05) = 2,052,000 rubles. As we see, the recommendation to include half of the annual output of new machinery in the calculation of the summary economic effect is in no way substantiated and may lead to gross errors. The recommendation evidently results from the confusion of the concept of the summary effect from the annual production of machinery and the effect for the first year of the machines that are put into operation.

The second simplification inherent in the determination of Θ_A^I consists in the assumption that in the course of the entire service life of both the baseline and the new machinery, their characteristics do not change: operating costs (gross expenditures on all types of repair), productivity, etc., remain the same.

In actual fact, of course, this is not the intent when averaged values of $H_1^{(n)}, H_2^{(n)}, B_1^{(n)}, B_2^{(n)}$ etc., are appropriately substituted in formula Θ_A^I . Such averaging is based on known formulas that take the time factor into account.

In calculations of economic effect Θ^I and Θ_A^I based on formulas (3) and (4) of the Methods, annual discounted costs considered among them have different economic content. A particular point of occasional confusion is that in formula Θ^I the corresponding values are related to the unit of output produced with the aid of new machinery and in formula Θ_A^I are related to the production and utilization of a unit of new machinery.

If new machinery is produced several years rather than in one year, it is legitimate to question the general economic effect of all machinery produced. Naturally, this effect equals the sum of effects Θ_A^I for the entire period of manufacture of new machinery calculated on the basis of the corresponding volume of its production every year. At the same time, the effect of every year in the summation must be reduced to the calculated year, i. e., to the commencement of production of new machinery.

The magnitude of the general or integral effect of new machinery can be determined on the basis of the following formula:

$$\Theta_{\Sigma} = \sum_{\tau=0}^{\tau=T_0} \frac{\Theta_A^{I,\tau}}{(1+E_n)^{\tau}} = \sum_{\tau=0}^{\tau=T_0} \left[3_1 \cdot \frac{B_2}{B_1} \cdot \frac{P_1 + E_n}{P_2 + E_n} + \frac{(H_1 - H_2) - E_n(K_2^1 - K_1^1)}{P_2 + E_n} - 3_2 \right] A_1^{\tau} \cdot (1 + E_n)^{-\tau},$$

where A_t^r is the annual volume of production of new machinery in year r ;
 $[0, T_1]$ is the period of production of new machinery; and $\Theta_A^{T_1, r}$ is the national
 economic effect of new machinery produced in year r reduced to year t .
 The integral effect Θ_z can also be calculated in a different way -- by
 summing the national economic effect not for the period of production of
 new machinery but for the entire period the machinery is in use.

Indeed the overall economic effect from the use of new technology in year
 t ($1 \leq t \leq T_1 + T_2$) is equal to the sum of the effects of machinery of differing
 age, i. e.,

$$\Theta_{\infty}^t = \sum_{r=0}^{t-T_1} \Theta^{t, r} \cdot \eta(t, r),$$

where $\Theta^{t, r}$ is the annual economic effect in year t from new machinery
 produced in year r and $\eta(t, r)$ is the indicator that shows whether machinery
 used in year t and produced in year r .

$$\eta(t, r) = \begin{cases} 1, & \text{if } r < t \leq r + T_2 \\ 0 & \text{-- in other instances} \end{cases}$$

Thus it is also easy to determine the entire integral effect during the
 entire period the new machinery is in use:

$$\begin{aligned} \Theta_z &= \sum_{t=1}^{t=T_1+T_2} \Theta^{t, r} \cdot (1 + E_n)^{-t} = \sum_{t=1}^{t=T_1+T_2} \cdot \sum_{r=0}^{r=T_1} \left[3_1 \cdot \frac{B_2}{B_1} (P_1 + E_n) + \right. \\ &\left. + (W_1 - W_2) - E_n(K_1^1 - K_1^2) - 3_2(P_2 + E_n) \right] \cdot A_2^r \cdot \eta(t, r) \cdot (1 + E_n)^{-t} \end{aligned}$$

Since

$$\sum_{t=1}^{t=T_1+T_2} \sum_{r=0}^{r=T_1} A_2^r \cdot \eta(t, r) (1 + E_n)^{-t} = \sum_{r=0}^{r=T_1} \frac{A_2^r}{(1 + E_n)^r \cdot (P_1 + E_n)},$$

it is readily apparent that the magnitude of the integral effect in the
 given instance is equal to the integral effect which we previously
 calculated for the entire period of production of new machinery. This
 can be illustrated by the following example (the time factor is neglected
 for the sake of simplicity).

Table 3

$\frac{t}{T}$	0	1	2	3	4	Total machinery Θ_t thous. rubles in year t	
1	200	—	—	—	—	200	40
2	200	300	—	—	—	500	100
3	200	300	500	—	—	1000	200
4	200	300	500	400	—	1400	280
5	200	300	500	400	100	1500	300
6	200	300	500	400	100	1500	300
7	200	300	500	400	100	1500	300
8	200	300	500	400	100	1500	300
9	200	300	500	400	100	1500	300
10	200	300	500	400	100	1500	300
11	—	300	500	400	100	1300	260
12	—	—	500	400	100	1000	200
13	—	—	—	400	100	500	100
14	—	—	—	—	100	100	20

Integral national economic effect $\Theta_T = 3000$

Let new machinery with a service life $T_2=10$ years be produced for $T_B=5$ years

($0 \leq t \leq 4$), the production volume for various years:

$A_0^t=200$; $A_1^t=300$; $A_2^t=500$; $A_3^t=400$; $A_4^t=100$ units (Table 3)

The total national economic effect from the production and use of a unit of new machinery during its entire service life is 2000 rubles (i. e., 200 rubles a year).

Then the integral national economic effect can be calculated either for years of production or for years of utilization of new machinery. In the former instance, it will equal $\Theta_T = 200 \cdot 2000 + 300 \cdot 2000 + 500 \cdot 2000 + 400 \cdot 2000 + 100 \cdot 2000 = 3,0$ million rubles.

In order to calculate the integral value of the national economic effect of conditions of use of new machinery, let us compile Table 3.

Thus the results of the calculations were identical. Nonetheless, the first calculation is significantly less labor-intensive and hence is more expedient for the problem examined by us.

However there is another circle of problems (e. g., how to evaluate the global effect for the national economy, for a ministry, etc., from the diffusion of various types of new machinery and technologies) where it is essential to make a direct calculation of the summary national economic effect in a given year. In such instances, notwithstanding the complexity of the calculations, it is necessary to determine Θ_t directly. It is not expedient to determine the summary values of Θ_A^T in these cases since various types of new technology have different service life, different periods of commencement of production, duration of production, etc.

In such a case, the summary values of Θ'_i can be found as

$$\sum_{t=1}^T \Theta'_i t,$$

where i is the subscript of the given innovation (machinery, technology) used in year t .

In this regard, yet another comment should be made concerning the procedure for awarding bonuses for new machinery. As we know, the size of bonuses for new technology is established on the basis of the annual economic effect

Θ' or for long-term means of labor -- on the basis of the magnitude of Θ_A^T .

We have shown that the full national economic effect must be determined for the entire period of production and use of new equipment. It seems that in the process of determining the size of the bonus, it is expedient to take into account not only the annual saving resulting from the use of new machinery but also the time of this economy, i. e., to take into account the service life of new machinery, the volume and period of its production. This will make it possible to orient developers toward the development of new machinery that will yield the maximum integral national economic effect and to alter the bonuses proper when necessary.

The analysis of basic formulas of determining the economic effect of new belongs to those cases in which the use of new technology does not motivate the customer to produce qualitatively new products or to alter production volume. Otherwise the criterion of comparative effectiveness will naturally not be minimum costs but will rather be maximum national economic net profit. In other words, in the static case the most profitable variant is established from the condition

$$\max_i [\Pi A_i - (C_i + E_s K_i)],$$

where Π is the price of a unit of output and A_i is the volume of its production under variant i .

When the compared variants of technical solutions are applied to a large product mix, i. e., when they are applied to the production of several types of products, the criterion of choice assumes more general form:

$$\max_i \left[\sum_j \Pi^j A_i^j - (C_i + E_s K_i) \right],$$

where K_i and C_i are capital investments and operating costs associated with the production of all products and Π^j is the price of a unit of product j .

In order that this type of criterion could be used in project planning, the choice of the optimum technical solution must be based on a substantiated price level and on the normative coefficient of effectiveness of investments. To a certain degree, the first problem is resolved by calculating the so-called upper price limit (see formula Θ_A^T) and the second problem is resolved by using national economic models of the definition of E_H which will be discussed subsequently.

3. The Nature and Magnitude of the Normative Coefficient of Effectiveness

Familiarization with the various methods that are in one way or another associated with the calculation of the economic effectiveness of capital investment and new technology readily reveals a significant flaw: the normative effectiveness E_H and the reduction norm E_{HN} in them is postulated (E_H at the level 0.12 or 0.15; E_{HN} at the level 0.08 or 0.1) and nowhere is it indicated the way in which the corresponding numerical values were obtained. And this is not by chance. In order to determine the significance of the effectiveness norm, it is necessary to ascertain its economic nature first of all.

The problem of ascertaining the essence of categories E_H and E_{HN} has long been a focal problem in economic science. Initially, research in this area was to a considerable degree conducted in isolation from the overall problem of securing effective and balanced economic growth, which has sometimes led to obviously incorrect conclusions.

Thus, at one time some authors espoused the view that the most effective variant was the one that ensured minimum routine costs which supposedly guaranteed the technically most progressive variant. Nonetheless, the insolvency of the given concept soon became obvious. First, such capital-intensive variants are by no means necessarily progressive. Second, no sensible capital investment fund exists for their realization. Naturally, practice has never been along these lines. Therefore, subsequent research was based on the firm foundation of the methodology of optimal national economic planning.

V. V. Novozhilov elaborated a model of current (one-year) national economic planning, from which it is possible to realize E_H . The essence of the model is as follows. It is required to secure the given growth rate of production for all products with a limited capital investment fund. The best variant is the one that ensures minimum routine expenditures throughout the national economy as a whole. The condition that the general requirement for capital investments not exceed their limit is the boundary of reduction of the volume of current expenditures. This model can be used to determine the degree of reduction of the volume of current expenditures if the limit of capital investments is increased by unity, i. e., the nature of norm of replacement of current expenditures by capital expenditures. And this means obtaining the evaluation of E_H .

There is another approach to the interpretation and evaluation of the effectiveness norm. It is based on the dynamics of expenditures that must be taken into account in calculations of the economic effectiveness of investments.

If we consider the fact that in real life the magnitude of current expenditures may change in time and capital investments are made over a period of several years, the question can be posed more broadly: are expenditures relating to different points in time equivalent? The majority of sciences answer this question in the negative. The natural conclusion is that we need a certain parameter that leads expenditures at different time to a

kind of "common denominator," i. e., an indicator that makes nonequivalent expenditures equivalent. This parameter has come to be called the reduction norm for heterotemporal expenditures $E_{\text{HП}}$.

The trend toward change in optimum evaluations of expenditures and results of production in time has been studied by a number of authors starting with L. V. Kantorovich with the aid of dynamic optimization models of the national economy. The standard formula for compound interest was used for reducing heterotemporal expenditures given sufficiently natural economic prerequisites. In the given instance, the reduction norm for $E_{\text{HП}}$ depends on the average rate of lowering of the evaluations and on changes in the purchasing power of the ruble (the latter is obvious; other things being equal, the growth of the purchasing power of the ruble leads to the lowering of $E_{\text{HП}}$ while a decline leads to the growth of $E_{\text{HП}}$). In such formulations, the reduction norm is identical to the normative effectiveness of capital investments.

Finally, let us note one more approach. As we know, the demand for capital investments depends on the nature of the potential measures that are chosen. Accordingly, it is expedient to have a control parameter for balancing the supply and demand for capital investments. The numerical value at which this balance is attained can also be interpreted as a variant of effectiveness norm $E_{\text{У}}$. Such an approach was investigated by A. L. Lur'ye. Unlike V. V. Novozhilov's formulation of the problem, A. L. Lur'ye did not introduce direct constraints on capital investments. In the resolution of the problem of securing the given growth of production, the optimum variant is the one that ensures the minimum of discounted costs. At the same time, the norm for reducing capital expenditures to current E_{H} serves as a control parameter whose numerical value should be selected in such a way as to ensure the balance of supply and demand for capital investments and the optimum distribution of their general fund among various branches. A. L. Lur'ye correctly believed that the higher the limit on capital investments the lower was the norm and vice versa.

Thus, in the given formulation normative effectiveness is viewed as a control parameter ensuring the balance of supply and demand for capital investments.

Thus we have defined at least three approaches to the calculation of the normative effectiveness coefficient. Investigating the socialist economy with the aid of optimization models, we can examine them in detail and compare one against the other.

Research has shown that each of the three approaches employs only one indicator to reduce heterotemporal expenditures and to compare current expenditures with capital expenditures. This is an important argument in favor of the proposition that it is not legitimate to differentiate between normative effectiveness and the reduction norm.* Since every approach

*L. V. Kantorovich, V. V. Novozhilov, A. L. Lur'ye and a number of other scholars always believed that $E_{\text{HП}} = E_{\text{H}}$ and that one category -- normative effectiveness -- exists. In our view, the different values of E_{H} and $E_{\text{HП}}$ used in the methods for new technology lower its methodological worth somewhat.

defines the magnitude of the effectiveness norm differently, its numerical value may also vary.

This is what happens when no relationship between these models is considered. We note that only L. V. Kantorovich's model is a model of long-range planning. Unlike the other two models, it does not need to provide constraints on annual production increments and limits on capital investments. While the models of V. V. Novozhilov and A. L. Lur'ye assume that the growth of production, prices on resources, capital goods, and limits on capital investments are determined from the solution of the long-range optimal planning problem, the physical plans and prices of products in these problems coincide with the corresponding fragment of the first problem. The numerical values of the effectiveness norm E_n also coincide.

Comparison of the investigated models makes it possible to draw yet another important conclusion. The effectiveness norm fulfills its basic function only if current plans and long-range plans are coordinated both with respect to planning targets and for capital investments and also in a scientifically substantiated pricing system.*

Consequently, the three approaches make it possible to formulate methods that are basically suitable for determining the effectiveness norm. Thus, the dynamic model of optimal planning of the national economy can be used to find the economic development plan, the corresponding system of prices and the value of norm E_n for each period of time. However, it is unsuitable for practical calculations since it has a number of difficulties associated with ascertaining the objective function (maximum satisfaction of human requirements), with the description of technological processes at the present and in the future, with regard to technical progress, and also with the large dimensions of the problems. The solution to the difficulties enumerated above should be sought in the formulation of a small-dimensioned macroeconomic model. But it should be assumed that there is an economic mechanism that brings the actual prices of concrete products and resources closer to the optimum. This raises the question whether mathematical economic models taking the basic properties of real economic processes into account can analytically produce a sufficiently precise formula for calculating normative effectiveness through observable macroeconomic parameters. Considerable attention is devoted to the solution of this problem in research by Soviet economists. Thus, L. V. Kantorovich and Al'b. L. Vaynshteyn investigated a one-product national economic model, adduced a convenient formula, and carried out a series of numerical calculations.**

*If the indicated conditions are not met, various kinds of corrections of the effectiveness norm and in particular its branch differentiation will not lead to the desired results.

**L. V. Kantorovich and Al'b. L. Vaynshteyn, "On the Calculation of the Effectiveness Norm on the Basis of a One-Product Model of Economic Development," *EKONOMIKA I MATEMATICHESKIYE METODY*, No 5, Vol 3, 1967.

A complicated variant of a model that takes into account the dynamics of the evaluations of capital, labor and natural resources was examined by S. A. Smolyak.* A work by S. M. Movshovich and Yu. V. Ovsienko** proceeded from the analysis of an optimal mathematical economic model that took into account the production, storage and shipment of products, the creation of new capacities with regard to lag time, and also adduced quite a simple formula for determining normative effectiveness through macro-economic parameters. Let us rewrite it in slightly modified form:

$$1 + E_{Ht} = \theta_t \left(1 + \frac{\Pi_t}{\Phi_t} - \frac{1}{\beta_t} \right)$$

Here, t is the time index; θ_t is the growth rate of fixed and working capital (the quotient resulting from the division of their value at the end and beginning of the year); Π_t is the volume of personal and social consumption in year t ; Φ_t is average value of capital for the year; and β_t is capital per worker (the quotient from dividing the average annual value of capital for the year by the wage fund).

If we consider that national income equals consumption plus the increment in the value of capital, this formula is transformed as follows:

$$1 + E_{Ht} = \theta_t \left(1 + \gamma_t - \delta_t - \frac{1}{\beta_t} \right),$$

where γ_t is the output-capital ratio on national income (national income in year t divided into the average value of capital for the year); and δ_t is the coefficient of capital growth (the absolute increase in the value of capital divided by its average value for the year). In principle, the given formula makes it possible to determine the magnitude of normative effectiveness through relative indicators (growth rates of capital, output-capital ratio and capital per worker).

From the formula, it is obvious that the higher the capital growth rate, the greater is the value of the effectiveness norm (the inverse interpretation may possibly be more natural: the higher E_{Ht} is, the higher is the percentage of society's resources that is diverted to accumulation thereby raising the growth rate of capital). Other things being equal, an increase in the output-capital ratio also increases the value of the norm. However, the

*S. A. Smolyak, "Determining the Discounting Norm," IZV. AN SSSR, SERIYA EKONOMICHESKAYA, No 1, 1977.

**S. M. Movshovich and Yu. V. Ovsienko, "Calculating the Effectiveness Norm on the Basis of an Optimal Planning Model," EKONOMIKA I MATEMATICHESKIYE METODY, No 4, Vol 10, 1974.

output-capital ratio is not the only factor that influences the value of E_H .

If the share of resources to be invested in accumulation is increased, given a fixed quantity of national income this will lead to the growth of the average annual value of capital and consequently to a decline in the output-capital ratio. Thus the given factors influence the magnitude of E_H in various directions. The coefficient of increment of capital operates in a direction opposite to the growth rate of capital since it has a minus sign in the formula. The existence of coefficient θ_t , which operates in the direction of a rise in the norm E_H and coefficient δ_t , which tends to lower it, reflects the twofold action of the accumulation process on the magnitude of the effectiveness norm. On the one hand, the increase in the effectiveness norm generates growth in the accumulation norm and on the other hand the growth of this norm reduces the value of E_H .

Finally, a magnitude inverse to capital per worker -- the worker-capital ratio -- tends to reduce the norm of E_H . Its influence on E_H is entirely natural. The higher the worker-capital ratio (and the lower the capital-worker ratio, correspondingly), ceteris paribus the lower will be the value of E_H . (The inverse interpretation is also expedient here: given low values of E_H , more labor-intensive variants are selected in which the capital-worker is lower). Strictly speaking, the application of this formula is substantiated if the actual prices are proportional to the valuations of the optimal plan. The given condition is hardly observed in an actual economic mechanism. The shortcomings of the existing pricing system are known. The scarcity or overabundance of various products (resources) are the consequence of imperfections in the system of prices. However, it can be considered that values of macroeconomic parameters belonging to the formula deviate less from the optimum than concrete prices since the deviations cancel one another out.

The following methods were applied to the component indicators of the formula in the process of adducing the formula. National income incorporated output of the nonproductive sphere; the capital evaluation of natural resources was included among capital; fixed productive capital was evaluated on the basis of replacement cost with due regard to depreciation; construction starts were also included in capital. In other words, capital here is interpreted in a broader sense as the total resources "frozen" in the production process. The payroll fund refers to the effectiveness of the labor activity of personnel which, as research shows, exceeds wages and must incorporate payments for the use of labor resources*

*See V. A. Volkonskiy, N. V. Pavlov, and V. B. Tkach, "On the Effectiveness of Labor Resources and Payments for Their Use," *EKONOMIKA I MATEMATICHESKIYE METODY*, No 1, Vol 14, 1978.

We do not exact payment directly for labor and natural resources. Nor is a capital valuation made of natural resources. Consequently, there arises the important problem of identifying parameters used in formulas analogous to reduced, actually observed values. Let us note, first and foremost, that since national income according to the present methods of calculation reflects the performance only of the productive sphere, all other values used in the formula must characterize only this sphere.

The problem of identifying actual economic mechanisms and such parameters of the model as payments for labor and natural resources is more complex. Nonetheless, the following approach to the solution of the given problem can be noted. One of the important functions of payments for labor and natural resources consists, as we know, in the equalization of the economic status of economic entities that operate under different natural and other conditions and that use labor power of varying skill levels. The natural question is: what are the real economic indicators that perform this function? It seems to us that we should include among them the following: turnover tax, the free profit remainder, and fixed payments. The formula examined above should be modified on the basis of these considerations.

Indeed if we denote the quotient from the division of the sum of these values by the average annual value of capital as σ_t , we obtain

$$1 + E_{nt} = \theta_t \left(1 - \gamma_t + \delta_t - \frac{1}{\beta_t} - \sigma_t \right)$$

When this formula is used to calculate E_{nt} , it becomes possible to use directly observable parameters: wages plus social insurance withholdings and the value of capital without regard to the capital value of natural resources.

Thus, all parameters in the formula should be calculated on the basis of actual cost-accounting relations. As they are improved, there must be appropriate changes in the methods used to calculate national income, the value of capital, to evaluate the labor of personnel, etc. We also note that when the economic status of various entities is levelled out, the marginal effectiveness of investments coincides with the average since entities operating under the best conditions pay higher rent and vice versa. The payments proper are viewed as an element of current costs. In our opinion, the remarks presented above should be included in our approach to the definition of the normative effectiveness of investment.

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LARGE-SCALE MATERIALS RECYCLING PROPOSED

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[Article by V. Ksintaris, first deputy chairman of USSR Gosstab: "Use of Secondary Material Resources in the Economy"]

[Text] With the expanding scale of social production and the growth of the population the economy is experiencing an ever greater need for raw materials, supplies and fuel. Yet every year it is becoming more expensive to extract the initial mineral products. The development of new deposits, which are usually located in uninhabited regions difficult of access, necessitates sizable capital investments for production development and to build transportation and power supply facilities. The costs of shipping the raw materials extracted to the regions where they are consumed have also been rising substantially. At the same time the problem of optimum use of nonrenewable natural resources is becoming increasingly urgent.

An ever greater role is being played in this context by utilization of industrial and household waste and by-products, whose use yields a sizable economic benefit.

L. I. Brezhnev noted in his speech at the 18th Komsomol Congress that one of the essential conditions for stepping up the drive for efficiency and quality is "... making a thrifty attitude toward material values belonging to the people the first law in the life and work of the Soviet people and persistently seeking out every new way of eliminating unproductive expenditures."*

Much work is being done in the country along these lines. It has great importance to the economy to discover and make fuller use of scrap and waste of ferrous and nonferrous metals. They represent many millions of tons. About 1 million machine tools per year can be manufactured solely from the metal obtained from metal machining.

* L. I. Brezhnev, "Rech' na XVIII s"yezde Vsesoyuznogo Leninskogo Kommunisticheskogo Soyuzha Molodezhi 25 aprelya 1978 g." [Speech Delivered at the 18th Congress of the All-Union Leninist Communist Union of Youth on 25 April 1978], Moscow, Politizdat, 1978, p 4.

Utilization of the bulk of metal waste and scrap in the steel industry is yielding a sizable benefit: a ton of steel obtained from scrap is one-twentieth as expensive as a ton obtained from ore. In 1978 1 out of every 3 tons of steel was produced from the scrap and waste of ferrous metals; total collection amounted to 47.6 million tons and total processing 26 million tons at enterprises of Vtorchermet [State Trust for the Collection and Processing of Secondary Ferrous Metals]. Better preparation of all the scrap collected for resmelting would make it possible to increase output by more than 3 million tons of steel per year at existing facilities.

The total economic benefit from utilization of scrap and waste of ferrous metals has been about 2 billion rubles, but it could be considerably more. In 1978 the scrap delivery plan was underfulfilled by 850,000 tons. Of the union republics only Moldavian SSR and Uzbek SSR fulfilled the targets assigned them.

It is difficult to imagine a more efficient industry than the recycling of nonferrous metals. If we compare the production costs of secondary nonferrous metals with the production costs of the corresponding metals obtained from ore, then, for example, 1 ton of secondary aluminum alloys costs one twenty-third as much electric power, ten seventy-fourths as much standard fuel, while production costs are two-fifths as high and specific capital investments one-eighth as high; in the case of bronze and brass alloys one-fifth as much electric power and ten thirty-fourths as much standard fuel are needed, production costs are two-fifths as high and specific capital investments are one-tenth as high. The situation is approximately the same in the production of other secondary nonferrous metals as well.

In 1978 the production of secondary aluminum and bronze-brass alloys, black copper and lead made it possible to reduce the economy's annual need for electric power by 2,500 million kilowatt-hours and its need for standard fuel by 1 million tons. Unfortunately, losses of nonferrous metals are still great because industrial enterprises and scrap and waste collection organizations are not paying sufficient attention to this matter. Because scrap is not piled separately where it is created processing enterprises receive a low quality of scrap: 70 percent for aluminum scrap, 62 percent for bronze and brass, and 70 percent for zinc.

Because ferrous and nonferrous scrap are mixed, enterprises of the USSR Ministry of Ferrous Metallurgy annually lose tens of thousands of tons of copper, which passes over into the steel as an impurity.

In 1978 1 ton of sulfuric acid in every 5 was obtained from waste gases at enterprises of the USSR Ministry of Nonferrous Metallurgy, the Ministry of Petroleum Refining and Petrochemical Industry, and the USSR Ministry of Ferrous Metallurgy. Yet at a number of enterprises of the USSR Ministry of Nonferrous Metallurgy a sizable amount of sulfurous gas is annually emitted into the atmosphere while hundreds of thousands of tons of elemental sulfur are consumed in the production of sulfuric acid. This matter obviously deserves serious attention of both technologists and managers in the economy.

The microbiological industry, created only 12 years ago, mainly uses the waste of agricultural production (rice and sunflower seed hulls, corncobs, and cotton hulls), sawmills and woodworking, but it produces many types of very valuable products. Yet the industry is experiencing difficulties in the delivery of waste. In 1978 the Moldavian and Ukrainian procurement industries failed to deliver 6,200 and 4,200 tons of corncobs, respectively, the Ministry of Procurements of Uzbek SSR was short 31,400 tons of cotton hulls--and this was in a republic which has a leading place in raising the country's cotton.

The large-scale production of fodder yeast, which has been built in the country, is highly efficient. At hydrolysis plants of the Main Administration for Microbiological Industry 420-450 kg of sugar are obtained in solution from every ton of low-grade wood. In livestock raising 1,000 tons of fodder sugar can replace more than 5,000 tons of sugar beets or as much as 20,000 tons of mangel-wurzel and can make between 1,700 and 5,000 hectares of plowland available for other crops.

A substantial amount of the people's resources can be saved through fuller utilization of refractory scrap. The country has an output of about 9 million tons of refractories. In 1978 ministries and departments delivered about 20 percent of refractory scrap for reprocessing. Most of the scrap collected goes into the production of new refractories, and part goes to the production of fire-resistant concretes. In addition, 1.5 million tons of refractories are used as a secondary raw material by the enterprises themselves. The total economic benefit from utilization of refractory scrap and used refractories is about 60 million rubles per year.

Much attention is being paid to this matter by the USSR Ministry of Ferrous Metallurgy, which at eight of its enterprises has already built mechanized installations for grading and cleaning refractories, which has made it possible to double the delivery of scrap. But we should note that matters are largely unsatisfactory in the collection of used refractories. Whereas between 21 and 26.5 percent of refractory scrap is delivered at enterprises of RSFSR, Belorussia, Latvia, Azerbaydzhan and Georgia, taking the republics as a whole, other percentages are 5.8 in Kirgizia, 2.7 in Moldavia, 2.2 in Turkmenia and 0.68 percent in Tadzhik SSR. A survey of 430 enterprises showed that 307 of them (71 percent) did not fulfill plans for collection and delivery of refractory scrap.

The consumer cooperative system is doing a great deal toward utilization of secondary resources. In the 3 years of the current 5-year plan 4.3 million tons of secondary raw materials have been collected through its efforts. The system already has 22 recycling enterprises in operation. In 1978 alone 158,000 tons of textile raw materials were recycled. We should mention that the recycling of 1 ton of woolen rags yields 700 kg of wool, the equivalent of shearing 175 sheep. Unfortunately, due attention is not being paid to this matter in all republics. Whereas in the Baltic republics and Belorussia the per capita collection of textile materials is between 2.6 and 3.9 kg,

in Kirgizia it is 1 kg and in Kazakhstan 800 g. Nor is the situation better in the Transcaucasian republics. It is obvious that local economic authorities should invigorate work aimed at fuller utilization of the potential for obtaining secondary raw materials.

Definite measures to improve the collection and processing of secondary material resources are being taken by USSR Gosnab, which in the 1975-1978 period built or rebuilt 432 production and procurement enterprises, set up 644 prefabricated production buildings with a total floor space of 343,000 square meters, 22 production lines for the processing of wastepaper and 773 hydraulic presses for baling it.

It has built or rebuilt 41 enterprises and shops at which 135 production lines have been installed for processing secondary textile materials. In 1978 33 million square meters of nonwoven materials were produced for various purposes, and their output will be raised to 52 million square meters in 1980. In recent years the production of fundamentally new types of nonwoven materials entirely from secondary textile raw materials or with a slight addition of primary raw materials has been developed and set in operation. These include floor coverings, wiping rags, thermal- and sound-insulating backing, the output of which was 13 million square meters in 1978, accounting for 67 percent of the production of linoleum with thermal backing.

Five production lines for the manufacture of heavy nonwoven textile materials with a total capacity of 5.7 million square meters have been put into operation at industrial recycling enterprises, making it possible to utilize more efficiently regenerated low-grade wool fiber and also synthetic fiber waste.

In 1979 six multipurpose lines were put into operation in Moldavian SSR, Uzbek SSR and RSFSR for processing used polyethylene film and fertilizer bags with a total capacity of 12,100 ton of finished products per year. The first experiments showed that products equal in their quality to products made from primary polyethylene could be made from 100-percent used polyethylene film with impurities up to 30 percent. Yet today only 6 percent of the potential supply of secondary polyethylene is being utilized. We should also take into account that 3 tons of gasoline must be consumed to produce 1 ton of primary polyethylene.

In 1978 organizations of USSR Gosnab collected a total of 4.7 million tons of secondary raw materials, which made it possible to produce industrial products valued at 1 billion rubles with an economic benefit of 790 million rubles.

In 1975 the All-Union Project Planning and Design and Technology Institute of Secondary Resources was created within the system of USSR Gosnab. It has carried out a number of interesting projects in the brief period of its existence. These include production development of new types of various nonwoven materials, floor coverings, and the recycling of polyethylene and polyvinyl chloride waste.

Work on removing impurities from paper scrap is very promising. A new procedure in the flotation process makes it possible to remove ink and practically reconstitute the primary fiber. Printing grades of paper have already been obtained from this raw material at experimental plants.

Our country possesses a tremendous potential for efficient utilization of secondary resources. The planned economy and the socialist mode of production create conditions favorable to solving on a national basis the entire range of problems involved in utilizing industrial and household waste. But our potential is not being sufficiently utilized, and as a result the country is being denied a great deal of valuable raw materials and finished products. For instance, at enterprises of the USSR Ministry of Ferrous Metallurgy alone 440 million tons of slag were piled up as of 1 January 1976. It costs between 0.4 and 1.6 rubles per ton to dump it there and maintain it. Enterprise expenditures for these two items alone annually represent 30 million rubles without the cost of the land given over to the piles in the limits of large cities.

The annual output of blast furnace slag is 46-47 million tons. Three-fourths of this is used in the production of building materials: the country produces 27.8 million tons of crushed slag, 4.4 million tons of slag blocks, 1.7 million tons of slag sand, 0.4 million tons of slag wool from smelting, and 60,000 tons of slag castings. The total benefit to the national economy of slag processing was 290 million rubles in 1976.

In ferrous metallurgy the level of utilization of secondary resources is as follows: 78 percent of blast furnace slags, 45 percent of ferroalloy slags, 16 percent of steel smelting slags, 17 percent of overburden rock, and 10 percent of tailings from ore enrichment.

In the coal industry about 800 million cubic meters of overburden are hauled to dumps every year. As of 1 January 1977 there were 2,080 such rock dumps occupying 50,000 hectares of land. Every year also adds approximately 50 million tons of tailings from enrichment, which is hardly used at all (less than 1 percent).

It is well known that most waste in the mining industry and enrichment can be effectively used in producing building materials. For instance, capital investments in making ballast from waste are barely half as high, and the production cost is lower (one-half--two-fifths).

For instance, at the Azovstal' Metallurgical Plant imeni S. Ordzhonikidze profit-loss departments have been set up as part of the blast-furnace and open-hearth shops to process slag into building materials and phosphorus fertilizers. The enterprise earns an additional net profit of more than 6 million rubles in processing 3 million tons of slag.

Utilization of tailings in the production of building materials deserves the attention of a number of departments. The State Commission for Stockpiling

Minerals of the USSR Council of Ministers, when approving reserves at mining and coal deposits, should in our opinion classify overburden as a reserve of building materials. When tailings operations are being planned, provision should be made for storing the rock separately as a function of characteristics; this is not to mention that the designs of such enterprises should immediately provide for production of building materials on the side. The expenditures for that purpose will be minimal.

A large economic benefit is also embodied in the recycling of the waste of chemical enterprises. Many such waste products can be used in various industries to obtain valuable industrial and household products.

Work is being done on a considerable scale in the Ministry of Chemical Industry to compile balances of emissions, effluents and waste and a general inventory of secondary material resources being formed in the industry. The existence of that data makes it possible to work out specific technical-economic variants for the recycling of waste and to properly evaluate the level of their ecological effect during storage.

According to data of NIITEKhIM [Scientific Research Institute of Technical and Economic Research of the State Committee of the USSR Council of Ministers for Chemistry], the annual yield of the principal types of solid waste of the chemical industry is about 100 million tons. It contains a number of useful components whose utilization would make it possible to save 20.7 million tons of primary raw materials in 1980. At the same time in 1980 an accumulation of 1.1 billion tons of piled waste is anticipated. Assuming that utilization of the waste of chemical production operations is economically feasible in most cases, this is a matter that deserves special consideration.

But if today we analyze the level of utilization of waste at the enterprise level, the pattern is very mixed. Whereas for the RSFSR as a whole the use of phosphogypsum is 54 percent, while at enterprises it varies from 39 to 97 percent; in the Ukraine it is 30 percent, in Kazakhstan 10 percent, and in Central Asia 7 percent. The Uralkaliy Combine uses 21 percent of its halite waste, while Beloruskaliy does not use it at all. Obviously, it depends greatly on local initiative.

It is an important problem to use the ash and slag of TETs. About 1 billion tons of ash and slag of TETs are in piles covering more than 21,000 hectares, and about 90 million tons are added annually. It costs about 10 million rubles to maintain the ash piles.

Methods that have been studied and the practice of a number of foreign countries show that though as much as 70 percent of ash and slag could be utilized, actual use does not exceed 10 percent. Meanwhile the use of 1 million tons of ash and slag instead of traditional raw materials to produce building materials would yield a saving of about 15 million rubles on capital investments.

According to the data of institutes of the USSR Ministry of Timber and Wood Processing Industry, approximately 80 million cubic meters of waste from timbering and woodworking are thrown away annually; their use would yield an economic benefit in excess of 1 billion rubles. We cannot say that this problem is not being solved. For example, in areas of RSFSR the level of utilization of timber waste varies from 0 to 43 percent, in the Ukraine 84 percent, in Belorussia 25 percent and in Kazakhstan nearly 100 percent. Everything depends on the attitude toward the matter and initiative.

In recent years collection of all types of secondary material resources has been growing very slowly because facilities for recycling them do not exist at industrial enterprises. For some types there is even a drop in the volume of recycling. For example, the Ministry of Pulp and Paper Industry has year after year been reducing the volume of utilization of scrap paper in the production of cardboard, and its total use at enterprises of this ministry is only 13 percent. Elsewhere in the world printing grades of paper are being made from scrap paper even today.

USSR Gossnab and Tsentrosoyuz have begun to set up their own recycling enterprises. USSR Gossnab is building the Kiev and Leningrad cardboard factories, each with a capacity of 200,000 tons of container cardboard per year, where scrap paper will represent 80 percent of the raw materials.

According to the data of the Ukrainian Scientific Research Institute of Paper, the use of 1 ton of scrap paper to replace wood and pulp in paper and cardboard production makes it possible to save 4 cubic meters of wood, 4.85 rubles of electric power, 5.17 rubles of industrial steam and 2 man-days of labor costs. Construction of just one factory with this capacity to use scrap paper would make it possible to save about 200 million rubles of capital investments.

The building of plants to produce 1,000 tons of secondary polyethylene reduces the costs of capital investments more than 1 million rubles if one takes into account the related expenses involved in production of primary polyethylene.

The recycling of used tires, which is hardly growing at all and represents 35.4 percent of production of so-called State Standard tires, is a very serious issue. Tires from automobiles and farm machines and steel-belted tires are not used to build them. In 1978 alone the recycling of used tires made it possible to save 144 million rubles by virtue of the difference in the costs of the raw material. Combined use of tires also makes it possible to obtain a sizable amount of textile cord and metal, which are their components.

One of the urgent problems is to utilize solid waste of households. In 1978 it exceeded 30 million tons in the country as a whole. At present this waste is mainly destroyed or stored in dumps occupying large areas (more than 14,000 hectares) which cannot be used for the subsequent 20-30 years as

farmland. Moreover, the dumps are a source of pollution for groundwater and streams and bodies of water as a consequence.

At the same time solid household waste contains valuable components. In 1978 alone metal, scrap paper, textiles, polymers and glass with a total value of about 400 million rubles could have been obtained from that waste. As confirmed by experience already acquired, it is very promising to build trash recycling plants which provide for combined use of the principal valuable components of household trash: scrap paper in the form of paper slurry, ferrous metals, plastics in the form of pellets, glass for recycling, and so on. Moreover, high-calorie livestock feed and also compost can be produced from the organic portion of solid household waste consisting of food scraps.

The recycling of secondary resources will greatly contribute to protecting the environment against the adverse effect of industrial and household waste. The broad scale of construction of treatment installations cannot yield a radical solution to the problem. Sizable funds are needed to build them and to operate them and repair them.

At the present time these outlays must increase faster than capital investments in the principal production operation.

It is well known that the most efficient method of protecting the environment is not to pollute it. The use of secondary resources will first of all reduce the arrival of waste at dumps. Moreover, when a product is made from secondary raw materials, there is considerably less ultimate waste. For example, when paper or cardboard are made from scrap paper, air pollution is reduced 86 percent and water pollution 25-44 percent, and the amount of solid waste drops almost 40 percent. The use of scrap metal in steelmaking reduces air pollution 86 percent and water pollution 76 percent, and the volume of waste is reduced by 97 percent.

In the very dawn of the creation of the Soviet state V. I. Lenin emphasized that "... in our economic work we need, though admittedly the word is not altogether suitable--what is known as 'stinginess.'"^{*} Under present conditions, now that the scale of the economy has grown immeasurably, this approach to the matter is becoming especially urgent. Today any oversight or error in this work is paid for in losses running to many millions.

Much attention is being paid in our country to optimum utilization of natural resources and material resources. Protection of nature and natural conservation for future generations are the basis of the policy of the party and Soviet state. The 25th CPSU Congress set the task of improving the organization of the collection of secondary raw materials and their recycling at specialized enterprises and of actively developing and applying manufacturing processes that guarantee reduced waste and maximum waste recovery.

^{*} V. I. Lenin, "Polnoye sobraniye sochineniy," Vol 42, p 361.

At the same time USSR ministries and departments and gosplans of the union republics are still not sufficiently concerned with the problems of using secondary resources and industrial and consumer waste, nor is provision being made for combined use of these resources in the design of new enterprises and in reconstruction of existing enterprises, nor in projects to develop manufacturing processes and equipment.

Approved plans omit assignments for utilization of secondary resources and production waste formed within industries and delivered from outside, as well as capital investments to build facilities for these purposes, which eliminates the possibility of using planning targets to influence the operation of production associations and enterprises in the utilization of secondary resources. Not enough work is being done on the problems of economic incentives and enhancing the interest of enterprises and organizations in collecting, recycling and using secondary resources and waste.

In our opinion the effort to solve the problems discussed above should be reflected in the planning targets of USSR ministries and departments and also those of all enterprises, including those under local jurisdiction. Provision should be made even in the design stage for use of waste where it is formed, or it should be put into marketable form for delivery to other industries for recycling.

There is a need to set up recordkeeping on waste and to include its use in balances of reserves of raw materials. It is very important that machine-builders and scientists take part in developing manufacturing processes and specialized equipment.

In working on these problems at the local level gosplans of union republics have a decisive role, and obviously they should be the leaders in this work, since utilization of the waste of production and consumption is a weighty addition to the resources of our national economy.

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AZERBAIJAN'S OIL FUTURE IN OFFSHORE DRILLING

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[Article by Kjell Dragnes: "Azerbaijan Islamic Soviet Republic: Historic Oil Center"]

[Text] A sun-drenched, open and unforested landscape stretches out on both sides of the road. Evergreen bushes are here and there. But otherwise and landscape is a forest--a forest of old and new drilling rigs. An unmistakable aroma of oil hangs in the warm air. This is the Apsheronski Peninsula which projects into the Caspian Sea like a parrot's beak. Baku, the capital of the Azerbaijan Soviet Republic, is here. Baku has almost become synonymous with oil, gas and the petrochemical industry. Oil has been the power behind the industrial development that this once-traditional Islamic society has undergone, both before and after the revolution of 1917.

The beginnings lie hidden in the darkness of long ago. But it seems clear that oil and gas were used in prehistoric times. Azerbaijan really means "Land of Fire". Gas seeped up to the surface through cracks and holes and caught fire. Eternal flames have burned here throughout the dark nights of the south.

The Arab historian Abu al-Hasan al Masudi wrote in the 9th Century "This is the only place in the world where white oil can be found. In this oil-rich place there is a volcano which always spouts fire."

Before Islam won over the minds of the people here they worshipped fire. There is still a fire temple outside Baku, which today is a museum. The eternal flames became a part of the folk art, and were cherished even after the victory of Islam. In the carpets of Azerbaijan, for which the land is almost as famous as it is for the oil, the theme of fire worship is reflected in stylized form. There are about 60 different ways of portraying fire knitted into the intricate patterns of the carpets.

The modern utilization of the oil deposits in Baku began 108 years ago. The Armenians and also the Nobel family made large fortunes here. Baku was so important that Czarist Russia in 1901 was the world's largest oil producer. It would be 74 years before the nation, now the Soviet Union, would be in first place again.

Azerbaijan has today lost its leading position to other and richer oil producing regions, first to Bashkiria and the oil fields by the Volga which gained the title of "the second Baku" and then to Western Siberia.

Now the republic provides about 3 percent of the oil production of the Soviet Union. But even though production has steadily fallen since the war, a significant quantity of oil and gas comes from the approximately 17,000 wells which have been drilled on land and sea.

The Soviet Union discontinued publishing statistics on oil production in the republic in 1976. The previous year Azerbaijan produced 17.2 million tons. It is difficult to wrest the figures for last year out of the authorities in Azerbaijan. But Foreign Minister A. Tairova says that last year's production was about 16 million tons of oil and 12 billion cubic meters of gas. This year's plan is for an increase of 800,000 tons.

It is doubtful if this goal, and likewise the goal for 1980, can be reached. Originally it was planned that Azerbaijan's production should reach 22.15 million tons at the end of this 5-year plan, which would be approximately the level of production of 1940.

But the chief of the state planning organization Gosplan, Nikolai Baibakov, struck a critical note in a speech in Baku earlier this year. He noted that plans for oil production were consistently not being fulfilled. "We are concerned over the increasing shortfall in recent years in the production of this valuable resource in the republic," said Baibakov. "It is possible to see in the statistics of the last 10 years that the decline from one year to the next has been more than a half million tons annually, in spite of all the plans for increases."

Parts of the Apsheronski Peninsula were covered with towers and pumps and pipelines. Some parts are unfortunately also covered with black and foul smelling pools of oil. Here and there pumps rock up and down. They remind one of sad hens plucking up the last grains from an old field. But most of the oil fields, after 100 years of exploitation, have given up their last oil using today's methods. New methods will enable the extraction of oil from fields which have previously been considered empty. Unfortunately these methods have not been used sufficiently, according to a report to the Azerbaijan Communist Party Congress of 3 years ago. Later information indicates that conditions have not been greatly improved.

The development of fields in the Caspian Sea has not gone quickly enough either. Neftani Kamni (Oil Reef) is an oil town on stilts about 10 miles from land. It produces the most oil, and with a major effort last year produced 125,000 tons over the planned goal.

Offshore fields today produce two-thirds of Azerbaijan's oil and gas, and here is where the future lies, according to Vice Premier Avisi Lembiranski.

The Serebrovski Field, named after the first minister of petroleum industry of the USSR, is a Neftani Kammi in miniature. Fixed platforms, partly joined by roads on steel pilings, stretch 6 km out from Pestshani Island, which is now a peninsula.

Every kilometer has cost millions of rubles to build, but regular production of 1.4 million tons of oil and 5 billion cubic meters of gas per year makes the investment profitable. Serebrovski really consists of two fields. The Bakhar Field a little farther out consists also of fixed platforms but does not have the connecting steel roadways. In spite of the investment the costs are considered low. In 1975 it was estimated that it cost 8 rubles (about 63 Norwegian crowns) per ton to produce oil at Baku.

Serebrovski was the first offshore oil field. Neftani Kammi was built beginning in 1949. But the Russians have relied more on onshore fields in other places, and they are therefore lagging in offshore technology. Today they are drilling in a water depth of 70 meters, according to Vice Premier Lembiranski. The deepest they can go in the near future is 125 meters.

As yet they do not have floating drilling rigs of the type used in the North Sea. In the Russian city of Astrakhan at the mouth of the Volga on the north coast of the Caspian Sea, the Russians are on the verge of assembling a Finnish drilling rig. It won in the competition with the Akers Group about 3 years ago.

Lembiranski said, "In Baku we have already started to build a shipyard which will build oil drilling platforms. Negotiations are underway with Japan and France for the delivery of machines and equipment for the yard.

"In 2 or 3 years time we will be able to launch platforms of the type used in the North Sea. That will make it possible for us to go farther out in the Caspian Sea and in greater depths," said the vice premier.

Even though the investment is great, the profits are also great. The oil from Azerbaijan is very high quality and has little sulfur and paraffin content. The refining of the petroleum is therefore simple and relatively cheap. Azerbaijan has, with its long traditions, built up a large petrochemical industry. But today the republic has too little crude oil to supply the industry by itself. The largest of the republic's refineries, Novo-Baku, gets half of its crude oil from Western Siberia in order to fill its capacity of 10 million tons annually.

It would be poor economy not to try to find closer domestic sources. But for the time being the chances of this are slim.

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